An Application of the Supply Chain Operations Reference Model for the Service Supply Chain for Standardised Back Office Services

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Declaration

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Abstract

It is common practice to apply manufacturing practices to services, with the intention of improving services through the practices of manufacturing. One of the manufacturing practices that has proven to be valuable in recent years is Supply Chain Management. In line with this, we have seen a growing body of research in the area of Service Supply Chain Management.

The greatest problem in Service Supply Chain Management, as indicated by the literature, is the ambiguity and complexity of services as opposed to manufacturing - where the concept of physical goods is easily understood. It is in this context, that researchers have found that it is challenging to apply current models for supply chain management to services in their current form.

The concept of services is a very broad term and this proves to be a challenge. There is a subset of services that is more suited to have manufacturing practices, like supply chain management, directly applied to it. The main objective of this study is to show that a supply chain reference model can be developed with little adaptation to a model developed within the manufacturing industry. This model would be suitable for services that are highly standardised and repeatable, and exhibit characteristics seen in the manufacturing industry.

The approach to the model adaptation is by using semantics, removal of elements (that relate to manufacturing) and limited addition of elements that relate to services. The objective is to create a model that is focused on standardised back-office services. The adapted service SCOR model is then tested for its usefulness. To test the usefulness of the adapted service SCOR model, the model is applied to a case study, which consists of two facilitated walk-throughs of services followed by a questionnaire assessment. The questionnaire was directed at assessing the usefulness of the models, which would only be the case if the constructs of the model were practical to the professionals assessing the model.

An adapted service SCOR model could be created for standardised back-office services by applying a structured approach to adapting the existing SCOR model. The adapted service SCOR model was found to be valid by professionals within standardised back-office services. There is a subset of services in which the supply chain management principles are more relevant and can be applied to services with a lesser modification.

An approach to the adaptation of the SCOR model is provided. This approach maintains the integrity of the original SCOR model while making the SCOR model suitable to the specific type of services.

This approach may be applied by practitioners adapting the SCOR model for their specific application but specifically for service sectors. In the application, the practitioner can then utilise the SCOR model concepts without having to create new concepts for services.

Therefore, it is believed to be a unique contribution in classifying services into distinct categories when applying supply chain principles, from manufacturing to service supply chains. It may also be expanded to manufacturing practices in general.

Opsomming

Dienste organisasies ondersoek metodes om hul bestuurspraktyke te verbeter en daardeur hulself 'n kompeterende voorsprong te bied bo hul mededingers. Dit is 'n algemene praktyk om vervaardigingsbeginsels toe te pas tot dienste met die doel om hierdie dienste te verbeter soos vervaardiging ook voordeel trek deur verbeterde bestuurspraktyke toe te pas.

Die motivering vir die toepassing van beproefde tegnieke uit vervaardiging tot dienste spruit uit die behoefte om dieselfde tekorte aan te spreek, naamlik: die ontwerp en bestuur van die toevoerketting, die bestuur van bates en die onsekerheid rondom die toevoerketting, en die uitdaging om kliente te verskaf met 'n diens wat hul behoeftes aanspreek terwyl dit baseer word met die beste waarde vir geld.

Die literatuur wys uit dat toevoerkettings vir dienste gekompliseer word deur die vae en komplekse aard gekoppel aan dienste in teenstelling met die vervaardigingsindustrie wat gebaseer is op 'n fisisie produk wat deur die ketting vloei.

Die uitdaging is dat die konsep van dienste 'n baie breë begrip is. Daar is in spesifieke groep dienste wat meer gepas is tot vervaardigingsbeginsels as ander dienste. Die hoof doel van hierdie navorsing is om te wys dat 'n model vir die toevoerketting vir dienste ontwikkel kan word deur klein wysegings toe te pas tot 'n model vir die toevoerketting uit die vervaardigingsindustrie.

Die aanpassings word benader deur semantiese veranderings, verwydering van konsepte wat nie van pas is nie (vervaardegings spesifieke termonologie) en deur konsepte uniek aan dienste by te voeg tot die model.

Hierdie studie wys dat ‘n aangepaste toevoerketting model ontwikkel kan word deur klein veranderinge (soos semantiese veranderinge) uit te voer op 'n bestaande toevoerketting model. Dit word toegepas op die SCOR model. Dit wys dat 'n toevoerketting model ontwikkel vir die vervaardigingindustrie aangepas kan word vir ‘n sekere groep dienste met minimale aanpassing.

Die aangepaste toevoerketting model word dan getoets vir dit nut van die model. Die nut van die model word getoets deur die model toe te pas op twee gevalle wat dienste van 'n gestandardiseerde gesentraliseerde aard verteenwoordig wat gevolg word deur 'n vraelys om die nut cvan die model te toets.

Die aangepaste SCOR model vir gestandardiseerde dienste kan dus ontwikkel word deur gestruktureerde stappe te volg om die oorspronklike model aan te pas na 'n model gepas vir gestandardiseerde gesentraliseerde dienste. Die model word relevant geag deur kundiges wat werk met gestandardiseerde gesentraliseerde dienste. Daar is dus 'n groep dienste waar konsepte van toevoerkettings soos ontwikkel vir vervaardiging maklik van toepassing is.

Hierdie benadering laat 'n praktisyn toe om die SCOR model aan te pas vir 'n spesifieke nuts toepassing maar laat verder toe dat die volwasse beginsels van SCOR toegepas kan word tot dienste deur gebruik te maak van klein aanpassings tegnieke.

Die klasifikasie van dienste gevold deur die toepassing van toevoerkettingmodelle tot hierdie dienste is 'n unieke bydrae.

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I would most importantly like to thank my wife, Anelia, and two children, Ethan and Gabriella, for the sacrifices they have made for this work to have been completed.

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List of Acronyms

EaaS	Everything as a Service
G-D	Goods Dominant
GDL	Goods Dominant Logic
GSCF	Global Supply Chain Forum
IP	Intellectual Property
IT	Information Technology
H-P	Hewlett-Packard
JIT	Just In Time
PSS	Product Service Systems
PSSC	Product Service Supply Chains
SCM	Supply Chain Management
SCOR	Supply Chain Operations Reference
SCS	Supply Chain Security
S-D	Service Dominant
SDL	Service Dominant Logic
SOSC	Service Only Supply Chains
SSC	Service Supply Chain
SSCM	Service Supply Chain Management

Chapter 1
Introduction

The objective of this chapter is to introduce the research undertaken and the approach to the research. The chapter commences with a brief theoretical background, which leads to the research problem, the formulation of the research questions and the research objectives. Thereafter, the dissertation scope is demarcated along with the research design and the methodology followed to address the identified problem. Finally, the chapter concludes with the outline or roadmap of the study.

1.1 Background

The service industry has grown tremendously, drawing greater attention to services and the practices of managing services optimally. This growth in the service sector leads to a need for greater understanding of the services industry and its complexity; as competitive advantage is sought after in the increasing competitive nature of services (Sengupta, Heiser, and Cook, 2006).

It is common practice to apply manufacturing practices to services, with a view of improving services through the practices of manufacturing. One of the manufacturing practices that has proven to be valuable in recent years is Supply Chain Management. In line with this, we have seen a growing body of research in the area of Service Supply Chain Management. The rationale for applying well-established models, that are founded in manufacturing, to services is to solve the same underlying challenges that Supply Chain Management aim to solve. These challenges are identified as: the management and design of the supply chain, the control of the supply chain assets, the uncertainties around the supply chain and meeting customers' needs in a cost-effective way (Ellram, Tate, and Billington, 2004).

The literature shows that this body of research is still immature and growing. These assertions will be elaborated further in section 1.2. The greatest problem in Service Supply Chain Management, as indicated by the literature, is the ambiguity and complexity of services. People interacting with traditional supply chains; easily grasp manufacturing and specifically the concept of dealing with goods. These concepts become abstract and often irrelevant, when considering services.

The general conclusion reached in previous research studies on the modelling of services in the context of supply chain management, is that services are materially different to goods. This results in the need for a total new supply chain modelling approach for services. Additionally, there is little re-use between modelling services and goods in the context of a supply chain. This conclusion will be discussed further in section 2.1.

At the same time, we are seeing fundamental changes in services (as will be discussed in section 2.1.1):

1) Greater push in the market for services to become standardised and automated,
2) Segregation of work, where services were once performed by highly skilled artisans, are now being standardised and automated to the point where it is either done by a machine or through lower skilled labour, and
3) Changes in the market where services, like travel agencies, have been usurped by travel websites like kayak.com.

It is changes like these that are turning services (that used to be hard to define and codify) into standardised "packages" of work. These standardised packages can be easily spread across a number of different providers with defined interfaces and quality. This is similar to the way manufacturing evolved from skilled artisans towards mechanised processes, where low-skilled workers could operate machines with high levels of production.

Abolhassan (2014) writes that services are being outsourced, as goods have been. In addition, multiple suppliers that may be located across the globe, as opposed to a close geographic location, are completing the services.

Whenever processes are optimized, attention also needs to be paid to quality when outsourcing individual tasks or production phases. Globalization and international competition have forced many companies to take a closer look at their value chains and find ways to save costs. Information Technology (IT) is no exception to this. Nearshoring and offshoring or outsourcing, are well-established responses but are often limited to processes that add little value. The question for the future is how it will be possible to procure services that are even more complex from outside partners, while keeping a consistent and acceptable level of quality.

To structure the approach to Supply Chain Management, the Supply Chain Operations Reference (SCOR) model has become the de facto standard in modelling supply chains. Although, it is important to note that the SCOR model does have shortcomings. The SCOR model is also limited in its application to services. The two most significant limitations to services lie in the semantics used within the SCOR model and the process types that may not be applicable to services (Georgise, Thoben, and Seifert, 2012).

One very useful dimension of the SCOR model is that it provides a number of constructs that can be used to model different supply chains. Each of these constructs has underlying measures and practices that assist in managing and improving the supply chain.

This thesis will study the application of the Supply Chain Management principles to services using the SCOR model. The SCOR model and its appropriateness as a chosen model, will discussed in detail in Chapter 3.

The type of services considered will focus more on services that are standardised and can be seen as commodity services, rather than focus on services that are hard to define and follow little standardisation or repeatability (e.g. consulting services and project management services). The type of service will be very significant to the overall thesis and will be referred to as industrialised services. Alternatively, these services are standardised back-office services, as shown in section 2.2.1.

In general, the conclusion reached by research studies of Service Supply Chains (SSC) is that services are fundamentally different to manufacturing. Consequently, the SSC need to be adjusted with total new modelling constructs and definitions to suit services. This view is correct, but it is only correct for a subset of services. There is no single definition for services; instead, there are many different types of services with different characteristics.

It is the premise of this thesis that there is a subset of services, the industrialised services (or the standardised back-office services). This subset lends itself to use the concepts of supply chain management that can build on existing Supply Chain Models, finding concepts that translate between the manufacturing and services industries, rather than redefine the model in its entirety. In this case, the SCOR model will be used as the base model. These industrialised services will also be shown to exhibit services categorised as standardised back-office services.

1.2 Research problem statement and questions

The relevance of services in the economy is growing. Service organisations are searching for methods to improve their operations and gain competitive advantage in the market. Supply chain management is a discipline from the manufacturing industry that has allowed manufacturing companies to improve their competitiveness.

There have been previous studies into the application of supply chain management to services. The general conclusion is that manufacturing is materially different and services require a new supply chain reference model in comparison to manufacturing.

It is the view of this study that this conclusion is valid but only for a certain class of services. There is a subset of services in which the supply chain management principles are more relevant and can be applied to services with a lesser modification. It is further maintained that the number of services that fall into this category is growing based on the changing nature of services.

Research into the types of services to which such an application of manufacturing-based supply chain management principles is relevant, as well as how these principles should be applied to such services, is however still lacking.

Research is needed in the enhancement of a supply chain management model, and here specifically the SCOR model. The SCOR model relates to services that exhibit characteristics similar to what we experience in manufacturing, and not services in general. Existing research typically use service concepts like consulting services or professional services. Yet, no study has focused on the specific class of industrialised services their relation to the SCOR model. The outcomes in applying the services characteristics to the SCOR model should then have application to service the supply chain management in general.

The research questions arising from this problem statement are the following:

1) How is supply chain management applicable to the services industry when considering a specific class of standardised back-office services?
2) How is the SCOR model applicable when considering a specific class of service and more specifically standardised back-office services?
3) Can a SCOR model be adapted to be useful in modelling a class of standardised back-office services while still maintaining the original integrity of the model derived from manufacturing?

1.3 Research objectives

By answering the above research questions, the main objective of this study is to show that a supply chain reference model can be developed, with little adaptation, so that it is suitable for services that are highly standardised and repeatable. These services also exhibit characteristics seen in the manufacturing industry. The intention is to develop the model in such a way that the original integrity of the model, derived from manufacturing, is still maintained.

In addition to the main objective, there are also a number of sub-objectives that the research will attempt to address. Specific sub-objectives include the following:

1) Study into a classification system of services, specifically as they relate to the definition of industrialised services and the implication of these types of services on supply chain management;
2) Analysis of proxies to concepts of manufacturing from the service industry, and specifically the study of proxies to inventory and examples from practice as this applies; and
3) The concept of the customer role in industrialised services and specifically the concept of simultaneity in the modelling of service supply chains.

The outcome of the research will thus be a model for service supply chains for standardised back-office services based on the SCOR model as the foundational model from which the Service Supply Chain Management (SSCM) is built.

This research is relevant to practitioners involved in the modelling and improvement of service companies. Furthermore, this research will contribute to considering how a specific type of service can be modelled as a supply chain and provide insights into the various approaches of modelling the services (e.g. proxies to inventory, areas of optimisation).

The research will further produce relevant best practices and metrics that have been adapted from the manufacturing practices and that could be used for services.

Accordingly, this will contribute to the overall competitive advantage of companies wanting to differentiate themselves in delivering services to their clients, by optimising the entire service supply chain.

1.4 Research design and methodology

As described in the previous section, the objective of the study is to show that there is a certain set of services that are useful to be described through existing supply chain models without major modification to the models. The approach to the design will be to take an existing supply chain model, and analyse to what extent the model must be adapted to fit a specific type of service. These services are standardised back-office services. The extent of the existing supply chain model adaptation will determine the extent to which one can assume that existing supply chain models are applicable to services without major modification.

Hence, this research will consist of model building. In approaching the research, it is useful to consider the research onion by Saunders, Lewis and Thornhill (2011), as cited in Saunders and Tosey (2012). In the research onion, research is classified according to layers. Layers are considered from the outside and as decisions are made on the approach from the outside, techniques on inner layers are formed. The research onion is shown in Figure 1 below.

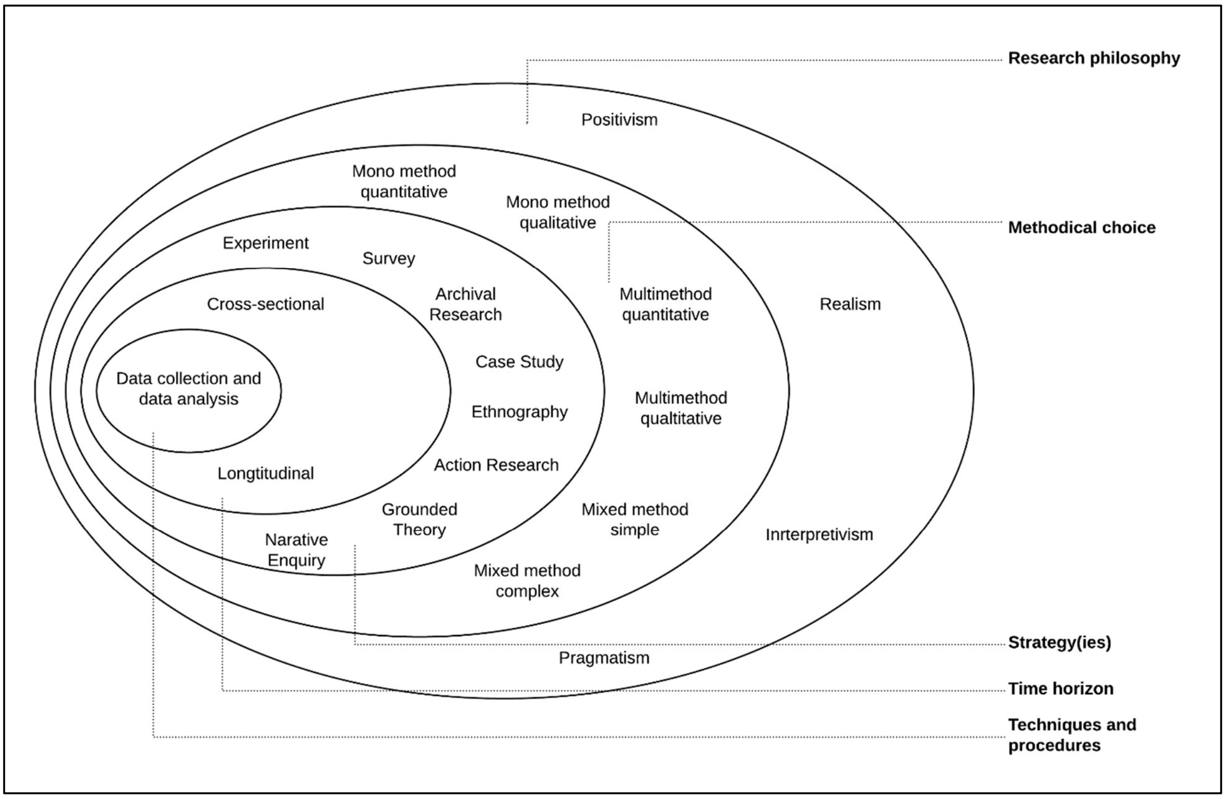

Figure 1: The Research Onion (Saunders and Tosey, 2012)

The first layer to the research onion is the Research Philosophy - which is broken up into Positivism, Realism, Interpretivism and Pragmatism. Positivism relates to a researcher interested in observing and predicting outcomes. Realism takes a view that reality exists independent of the mind and that the researcher's perspectives influence their view of the truth. Here, distinction is made between

Direct and Critical Realism. In Direct Realism, the researcher's observations provide an accurate representation of the truth. Critical Realism refers to a need to find out what is immediately experienced, as well as consider the structures and relationships that lie beneath it. The outcome is that collection techniques are a mixture of qualitative and quantitative methods. Interpretivism refers to an instance where the researcher is more concerned with obtaining rich insights, rather than law-like generalisations. For Pragmatism, the importance of the research is on the practical consequences. Here, no single viewpoint can give the entire picture. For Pragmatism, the researcher will use a number of different research techniques that should result in credible and reliable data.

The approach in this research is a combination of Pragmatism and Critical Realism. The purpose of the study is to create a model to explain one view. The view that supply chain management, as applied in manufacturing, is relevant to a certain set of services. As part of this Pragmatist approach, the relationships of services to manufacturing, as well as the relationships between different types of services, are explored. Thereby, bringing in the Critical Realism perspective. The Pragmatist approach is again brought in in the validation of the model, as the model is tested for its usefulness as has been described in section 1.2 on the research problem statement.

The next layer is that of methodical choice. On the methodical choice, the methods may be:

1) A single data collection technique (mono-method quantitative and mono-method qualitative),
2) Multiple methods (multimethod qualitative and multimethod quantitative),
3) Mixed method, using both qualitative and quantitative methods, which can be classified as simple or complex.

The approach taken in this research is a simple mixed method. In this method, participants are taken through a facilitated workshop explaining the model, followed by a questionnaire to quantify the experience of the participants of the model. The quantification is on a very simple level with no complex statistical analysis.

The following layer is that of strategies. The strategies are: i) experiment, ii) survey, iii) archival research, iv) case study, v) ethnography, vi) action research, vii) grounded theory and viii) narrative enquiry. The approach taken in this research is to use a case study to facilitate an understanding of the created model.

The next layer is the time horizon. The time horizon is either cross-sectional horizon or longitudinal. The cross-sectional time horizon is a snapshot of a particular time. Typical methods associated with cross-sectional horizons are surveys or case studies. The longitudinal study is a study over a long period.

This research uses the cross-sectional horizon using case studies and questionnaires as input.

The approach taken to the research design, in line with the philosophy discussed above, is further described by Mouton (2001:176-178) as Theory-building or model-building strategies. Mouton (2001:176) describes model-building strategies as, "Studies aimed at developing new models and theories to explain particular phenomena". The key research questions when taking the model-building approach are:

1) Questions of meaning and explanation;
2) Questions of theoretical linkages and coherence between theoretical propositions; and
3) Questions related to the explanatory and predictive potential or theories and conceptual models.

This approach is applied in studies where new models are created or where existing models or theories are refined. The studies are described as being theoretical or conceptual. This reasoning, or conceptualisation, occurs through either inductive or deductive approaches. In the inductive approach, a model is created with the view of finding a model that will fit the empirical data available. A variation of this inductive approach is analogical reasoning, where one model is created based on the similarities to another model.

Deductive approaches to theory construction are much more formal. "A set of postulates or axioms is formulated and taken to be true. From these postulates, further theoretical propositions are deductively derived. This process is followed until a comprehensive set of theoretical propositions has been developed that will ultimately be tested against empirical data" (Mouton, 2001:77).

This study will follow the deductive approach as described by Mouton (2001). An existing supply chain model will be used as an existing model. This model will be adapted from the existing manufacturing context to the services context. Literature will then be studied to create a number of principles or axioms within which the existing model will be adapted, in a very controlled and precise way. These axioms will be formulated out of two bodies of knowledge. The first body of knowledge will be axioms created out of the research of the nature of services, and the differences between services and manufacturing. The second set of axioms will consist of the body of knowledge related to the adaptation of supply-chain models. The combination of these two bodies of knowledge and the associated axioms will result in a set of principles within which the existing model will be adapted which will have as a result a supply chain model suited to standardised back-office services.

One of the strengths of the approach is that science needs good models to progress the understanding of the world. Good theories and models are able to allow the explanation of phenomena and behaviour observed in the world, allowing one to make predictive claims under certain conditions (Mouton, 2001). This model will be created in this study by applying the principles, described in the previous paragraph, to an existing model to create a newly derived model. This model will then be applied to a case study containing two scenarios of service supply chains. In this approach, the adaptation of the model must be of such a nature that it keeps to the integrity of the existing model. The overall objective of this study is to test if there are certain sets of services that are of such a nature that manufacturing practices can be applied to these services without major modification. The goal is thus to create an adapted supply chain model. However, this adapted model should still remain very similar to the original model, to show that the original supply chain concepts are easily applied to a certain set of services.

Limitations of the approach include the fact that the theories are not effective if they make implausible claims on reality, make claims that are vague and very difficult to test or are incoherent, inconsistent or confusing (Mouton, 2001). It is with this in mind that the created model must be tested. The model will be tested by being applied to a case study containing two service supply chains where these scenarios are representative of two services that can be classified as standardised back-office services. Professionals in the service industry to assess the usefulness of the developed model will then test the application of the model to the two scenarios and to what extent it explains the actual scenarios. It is important to note that the usefulness of the model must also be tested, as simply having a model that explains the phenomena is not sufficient, it must be useful in the context of what is expected of a supply chain model.

Main sources of error are associated with creating theories that are over abstracted to the extent that empirical validation is impossible. The main causes of error include the creation of a model based on incorrect assumptions or the incorrect use of statistical data. The validation of the newly created model will be through a questionnaire. The questionnaire will be based on the case study analysis performed by the professionals in the service area being studied namely, standardised back-office services.

Applying these principles to the research questions, deductive approaches will be used to derive a Supply Chain Reference model that is applicable to standardised services. This will be applied specifically to the SCOR model and will be based on i) principles generally found when considering the differences between services and manufacturing and specifically the differences observed when considering supply chain management and ii) principles derived by observing the adaptation of the SCOR model for other applications. This is then lastly verified for its usability through the application of the model in a case study of two service supply chains which is assessed by practitioners of standardised services through a questionnaire.

This section explained the model followed for the research based on the approach of Theory-building or model-building strategies as described by Mouton (2001). These steps described by Mouton (2001) are applied in the approach to this study to investigate if there are certain sub-sets of services to which the manufacturing principle of supply chain management can easily be applied.

1.5 Delimitations and limitations

The scope of research is bounded in the discipline of Supply Chain Management (SCM) and the research into Supply Chain Management is grounded within the SCOR model. The selection of the SCOR model will be explained in Chapter 3. Within the context of the SCOR model, the scope is limited to the Level 3 process elements together with the performance metrics associated with the process elements up to Level 2 (the SCOR levels are described in section 3.2).

Level 3 process measures are excluded. Although they are supposed to be independent of the specific Supply Chain being modelled, they are specific to an industry. Moreover, within this context, the wide range of industries covered by services may be too broad and general to be of any use as a general theory to service supply chains.

Furthermore, excluded from this body of work are the best practice dimensions for services as this will also be very specific to an industry, which may be too broad for services.

The research further describes service industries in general but then focuses on a very specific classification of the service industry, described as the standardised back-office services (described in section 2.2.1).

Models that focus on specific services will have to be considered and may result in work focused on IT services with discussion of the general applicability of the conclusions to other industries.

1.6 Dissertation outline

The outline of this dissertation will follow the structure described in section 1.4 and is depicted in Figure 2.

The research first focuses on the field of services as described in Chapter 2. The goal of this section is to accurately describe the nature of services through the evolution and describe the characteristics of services. Specific focus is given to the differences between services and manufacturing as industries. These differences are based on this study focusing on using a manufacturing developed concept, which is supply chain management, and applying it to services. Attention is also given to a classification of services. The hypothesis put forward in this study is that there is a specific set of services that are more suited to applying the concepts of supply chain management, as opposed to services in general.

This is followed by Chapter 3 that looks at the concept of supply chain management models to highlight the use of the SCOR model and its nature. Research is then conducted into the techniques used in adapting the SCOR model to formulate principles according to which the model can be adapted without compromising the integrity of it.

Chapter 4 uses the principles laid out in the foregoing two chapters and applies these principles systematically to the existing SCOR model. Chapter 4 shows the stepwise application of the principles, together with a summary of their outcomes after being applied to the original SCOR model. The output contained within the chapter is important as it shows to what extent the SCOR model had to be adapted to fit a specific classification of services. The actual model that is produced, as part of this stepwise approach, is included in Appendix A.

The created model is then tested based on two facilitated walk-throughs that are created using the adapted service SCOR model. This process is described in Chapter 5, although, the chapter does not describe the actual facilitated walk-throughs. The facilitated walk-throughs are merely the application of the model to a specific scenario. The case study is included as part of Appendix B. The case study is discussed in Appendix B by providing a guided walk-through to the reader of the facilitated walk-throughs. It also illustrates how the model is applied to the facilitated walk-throughs to eventually model and improve the situations described in the facilitated walk-throughs. Chapter 5 focuses on describing the changes that need to be considered in applying the model because the supply chain model was used to model services and not the traditional application to manufacturing. The chapter then refers to the process where users evaluate the model used to describe and optimise the supply chains provided in the case study. The evaluation is discussed for its validity and the conclusions that can be drawn from the evaluation.

Chapter 6 describes the unique contribution made in this study, conclusions that can be drawn from the study together with areas for future research.

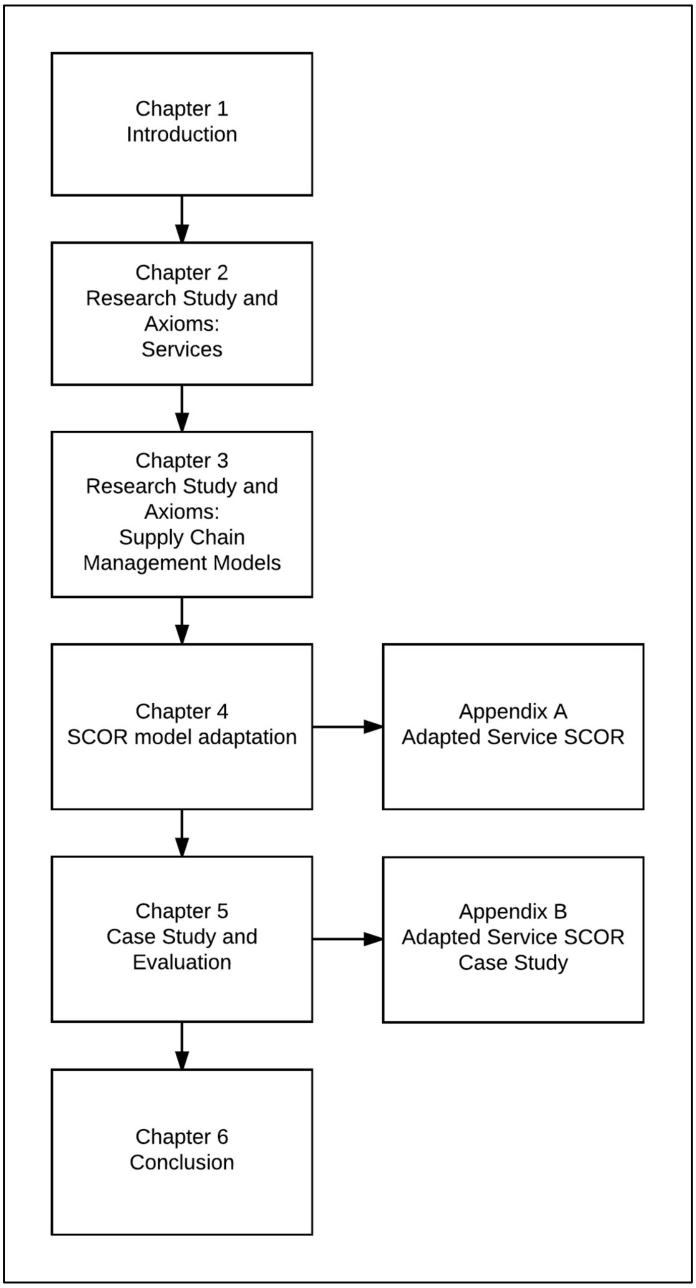

Figure 2: Dissertation Outline

Chapter 2
Literature Review: Services Overview

In developing an adapted SCOR model for the services industry, in the form of a Service Supply Chain, it is important to understand three concepts: supply chain management itself and the nature thereof, services and the nature of services, and research and literature on the different service supply chain models.

These dimensions to services need to be studied to better understand the nature of services together with the requirements of supply chain management. These concepts are then considered together to derive principles within which services can be studied for the application of supply chain management.

The last two sections describe two areas that highlight challenges in modelling service supply chains, which has more discussion in literature related to these dimensions and which warrants further discussion. The first is a discussion on capacity management within services. The next is finding equivalent constructs to inventory in services' supply chains. The concept of capacity within the goods supply chain is easily understood and includes well-known strategies for coping with capacity constraints like carrying inventory or stock. There are no equivalent strategies carrying inventory within services, although there are different coping mechanisms to capacity management in services. The section of proxies to inventory, considers what the item is which flows within the supply chain. Core to modelling a goods orientated supply chain is tracking the item that flows. There is no physical item that flows in services. To cope with this, many authors approach this complexity by modelling an item that flows; this then serves as an equivalent to a good that flows in the manufacturing supply chain.

2.1 Manufacturing and Services

It is useful to consider the differences between services and manufacturing. Although authors proceed with caution when trying to fit manufacturing concepts to services, a large part of the thinking from supply chain management originates from manufacturing. Furthermore, it is the premise of this study that the SCOR model, a supply chain reference model primarily intended for goods, is applicable to a certain class of services, which exhibit traits similar to the manufacturing industry.

This chapter will consider the concepts of manufacturing as well as services. This section will first consider the evolution of the manufacturing industries. This evolution is important as the concepts that become more relevant when considering supply chain management, are because these industries mature over time, from bespoke artisan-driven industries to factory-driven industries. Thereafter, the differences between the manufacturing and services industries are studied, leading to a definition for service supply chain management as well as the rationale for studying service supply chains. It is important to consider the purpose for studying service supply chains as this is a major driver in developing a model for service supply chain management - as it highlights the eventual goal of such a developed model.

The following section will consider and define services. Additionally, it will look at different models for services and very specifically consider a description of services, classifying them in the dimensions of standardisation and customer contact.

The concept of manufacturing supply chains will be briefly described. This will only be done as an introductory element to introduce the concepts of service supply chain management because the manufacturing supply chain is well researched and not the primary focus of this study.

Thereafter, models that describe service supply chain management will then be discussed. This is done to highlight the major approaches to service supply chain management that have been found in literature, and to discuss the merits of each approach and the relationship of the approach to the eventual objective of the model.

2.1.1 Evolution of Manufacturing and Services

To understand the evolution of manufacturing, consider the construction of horse-drawn carriages over 200 years ago. Craftsmen who would invariably be more successful depending on the level to which these craftsmen were the most accommodating manufactured these carriages. This was eventually overtaken by mass production as customers placed more value on standardised goods, as opposed to personalised goods that cost more. The result was the increase in compartmentalised work through a division of labour (Chase and Garvin, 1989). This observation serves as one of the starting points of the evolution that we have seen in industry. Manufacturing as an industry is seen as extremely standardised and process driven, but we have not always had such a level of standardisation. Initially, the items we now regard as standardised or mass-produced, were produced by craftsmen that could be likened to artists. The work we now see as standardised would have been regarded as not capable of standardisation and difficult to define. However, this manufacturing industry has undergone a transformation into the level of mass production and standardisation we now accept as a characteristic of products.

Similarly, services have been, and largely still are, regarded as difficult to standardise and something only accomplished by a very skilled practitioner for which there is no set formula or process. There is a global shift in industries from the agriculture industry towards services (Spohrer, Maglio, Bailey, and Gruhl, 2007). This is supported by Sampson (2000), who remarks that as more developed countries moved from agrarian based to manufacturing based, these economies have continued to progress. The economies become predominantly service-based and services now account for two-thirds of the output of the advanced economies of the world. With this shift, we are seeing a transformation of services towards more standardised services that follow set processes or higher standardisation.

One of the base principles of this thesis is that services are evolving towards types of services that are closely related to manufacturing. Thus, making concepts from manufacturing (and more specifically Supply Chain Management) more relevant to services in general. Therefore, it is useful to study manufacturing and its evolution, to establish parallels to services and the changes in services as we are currently experiencing them.

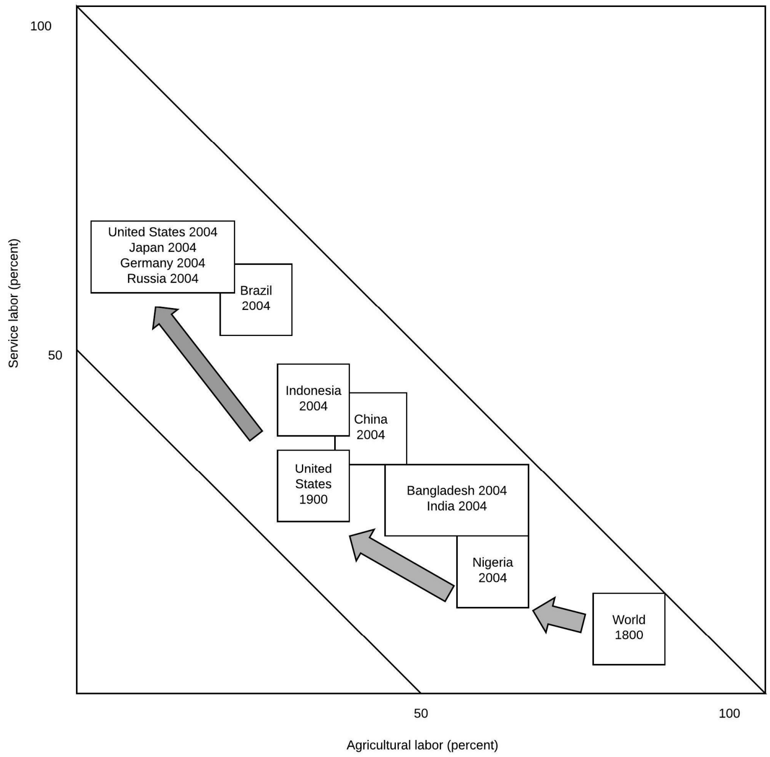

Figure 3: Global Shift of Labour (Spohrer, Maglio, Bailey, and Gruhl, 2007)

Figure 4 shows the evolution of the manufacturing industry. The manufacturing industry has seen an evolution from individually crafted products, with bespoke features suited to each customer's requirements, to mass-produce standardised products.

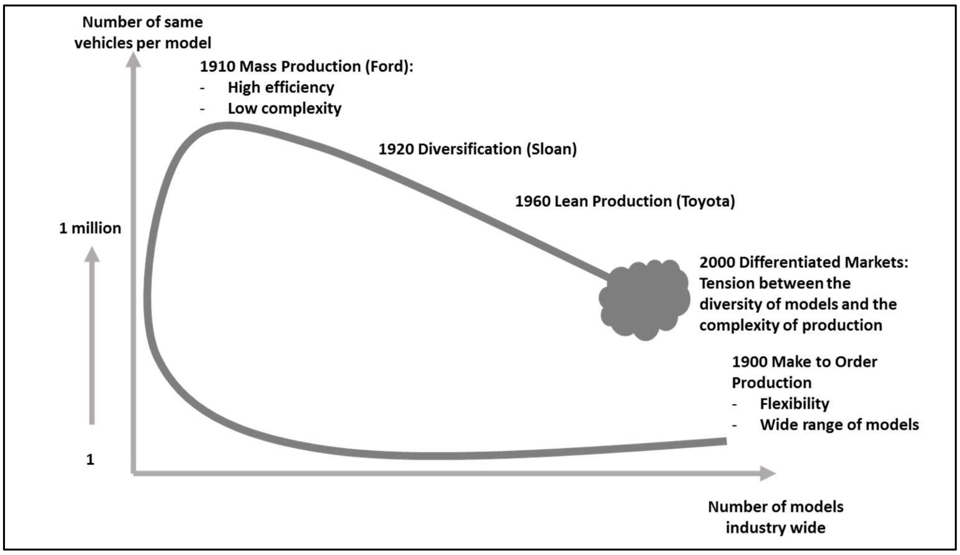

Figure 4: Evolution of Manufacturing (Grimme and Keutter, 2014)

As with manufacturing, we are seeing an evolution in services from very bespoke and unrepeatable products (as originally seen in manufacturing), towards standardised and repeatable products or outputs. The changes in services differ between industries. Service industries in banking and insurance have seen these standardised back-office processes for a few years now. Techniques traditionally linked to the manufacturing industry, like the well-known manufacturing technique of Lean, have recently become more common in services industries. Banks were one of the early adopters of these principles, applying the techniques to their back-office processes that naturally evolved to include their customer facing processes. The common misconception that the use of techniques and the drop in the cost of the process would lead to a reduction in service quality has proven not to be the case. The application of these manufacturing practices to the services industry has not only resulted in an increased productivity, but also an improvement in quality (Löffler and Reinshagen, 2014).

Travel agents, who used to arrange the travel programmes for their clients have seen a decrease in the use of their services, with customers opting to use the Internet over the past ten years. Customers are able to put their own packages together using the tools readily available to them online (Maull, Geraldi, and Johnston, 2012).

Uebernickel and Brenner (2014) point out the similarities between the IT sector and the developments in the manufacturing industry. Industrial manufacturing has passed a number of milestones as it has matured over the past 100 years. Starting with standardisation and then streamlining of process flows, continuing with the explicit assurance of quality, and culminating in an end-to-end customer focus in production (Uebernickel et al., 2014).

The focus of this section thus far has been to show a progression in manufacturing and that it may be observed within services. There is a further dimension to this view. Not only are services evolving as manufacturing has evolved, but from the discussion in this section it should also be noted that manufacturing practices are migrating to services. Sampson (2000) explains that supply chain management clearly emerged out of manufacturing contexts. Furthermore, the important supply chain management models and principles also originate from manufacturing. Then, in considering service management, Sampson (2000) argues that these are in fact manufacturing techniques applied to services and are not considered appropriate. This view is supported in the light of services outsourcing. Sampson Spring (2012) state that the practices linked to services outsourcing are influenced by the practices associated with goods, even though there is reason to believe that the application of these practices have been inappropriate.

There are arguments for and against this type of influence of manufacturing on services, which are explored further in this chapter. It cannot be denied that manufacturing practices have spilled over into services in their application. The following section will continue with this approach by considering the similarities and differences between the services and manufacturing industries.

2.1.2 Differences between Manufacturing and Services

In considering the application of concepts that are rooted in manufacturing, like Supply Chain Management, to services it is necessary to consider the differences between services and manufacturing. The focus of this section should be to describe services and manufacturing in the context of:

1) Understanding the differences between manufacturing and services gives context to the argument that there are similarities between services and manufacturing. These similarities are sufficient to the point where manufacturing practices can be applied to services.
2) On an operational level, it is important to understand the differences between manufacturing and services. As this becomes the basis for content when building an adapted model of Supply Chain Management targeted at services.

As already described, supply chain, management (SCM) in manufacturing is considered easy to understand. The general approach in SCM is to find the items that flow, and in manufacturing, these items are tangible and usually easy to identify. The essential difference between a product and a service is that a service requires involvement from the customer to be produced and that services are intangible in nature (Grimme and Kreutter, 2014). Other authors reach a similar conclusion that, “pure services are intangible, labour intensive, heterogeneous, cannot be stored and transported because production and consumption occur simultaneously, have a high level of customer influence, and have a quality dimension that often is difficult to judge” (Akkermans and Vos, 2003:205). According to Kathawala and Abdou (2003), a major difference between manufacturing and services is the lack of a physical product. The implication of this difference is that you cannot put it as inventory, because the product sold is the number of hours of the professionals and employees involved in the assignments.

Services are seen as complex and the field of service management is difficult to improve. This is due to the difficulty of visualising services. Services are concretised and defined through service level agreements and statements of work. These service level agreements and statements of work are not as easily defined as specifications for manufactured goods. There is also a general belief that service quality and performance are not as easily measured and specified objectively as product quality and performance (Ellram, Tate, and Billington, 2007).

Allen and Chandrashekar (2000) summarize the differences between services and manufacturing in Table 1.

Table 1: Manufacturing and Services Difference (Allen et al., 2000).

	Manufacturing	**Service**
Definition of Expectations	Precise. Represented by engineering drawings and standards.	Usually imprecise. Broad definitions with many exceptions.
Quality	Emphasis on objective and measurable criteria.	Some objective and many subjective and perception-based criteria.
Points of Contact	Few. Communication usually channeled by a few people, such as purchasing or the project manager.	Many. The service provider often interacts directly with end users as well as the program managers
Physical separation of host firm and contractor facilities	Separation is normal from host company. This allows the use of any contractors--- even international--to control costs, etc.	Separation is difficult as most services must be provided on the host company's site and cannot be inventoried or stored.
Predictability of demand	Dependent on the accuracy of forecasts for final customer demand	Dependent on both internal priorities and external demand, both of which are dynamic
Work content/cost determination	Work content is a direct function of the number of units consumed, so costs are easy to determine.	Work content is situation specific, so needs to be monitored and accounted for
Security of information/data	Information can be shared with contractors on a need-to-know basis	Contract workers may be exposed to confidential information during the delivery of their services (hallway conversations, access to restricted areas).
Problem resolution	Formal procedures with clear responsibilities can be easily specified.	Difficult to create a process because problems often occur due to interpersonal issues or vague, ill-defined expectations; problem resolution requires greater flexibility.
Transition between contractors	With planning, it is usually possible to change contractors with no noticeable effect on supply; inventory can be maintained during change,	Transition is more visible, requires more communication to minimize problems; disruption is often unavoidable because services cannot be stored and new contract workers are introduced to the site.

Sampson (2000) draws the conclusion that services and manufacturing are markedly different with a different managerial approach. Akkermans and Vos (2003) take a slightly more conservative view but still warn that not all principles applied successfully for products, can automatically be assumed relevant in service environments.

Studies into SSCM not only highlight the differences, but also similarities. Concepts like demand management, customer relationship management and supplier management, which are important in manufacturing supply chains, are also important in service supply chains (Sengupta, Heiser, and Cook, 2006).

Although services may be different, this may only be in certain cases. There are types of services that may be more similar to manufacturing concepts. One such example is the industrialisation of IT. This topic will also be touched on when considering section 2.2.3. Relevant to this section though, is that this industrialisation of IT refers to the use of management concepts and methods from industrialised manufacturing to IT (Grimme and Kreutter, 2014). The four pillars of industrialization are given for the industrialization of IT:

1) Standardisation and automation
2) Modularization
3) Continuous Improvement
4) Concentration on core competencies.

Grimme et al. (2014) further explains that this industrialization results in an attempt at "productifying" services.

Thus, there exists a contradiction in literature between viewing services as something different from manufacturing, contrasted with the industrialisation of services, and the concepts of services becoming more suited to traditional supply chain modelling techniques. It is the premise of this study that the changes in services are making certain services more suitable to be modelled as supply chains. The key lies in the classification of services and identifying the types of services where SCM, from the manufacturing industry, may be more suited to these services as opposed to others.

The conclusion from this section is that literature has identified many differences between manufacturing and services. Although, these differences all have a context and depend on the context within which the supply chain is viewed as well as the type of services being considered. The thesis will thus look to identify the differences within supply chain management when considering manufacturing, as opposed to services. Moreover, it will try to contextualise these differences in terms of the different types of services that may be modelled. Lastly, the concept of proxies to inventory (or product) will be discussed. The choice of what is modelled will have a large impact in understanding - if principles that are well established in manufacturing - are easily applicable to certain types of services that relates to the proxy to inventory.

2.1.3 Definition of Service Supply Chain

Up until now, the focus has been on describing topics relevant to manufacturing and services, with specific attention to supply chain management. This section will consider the various definitions of supply chain management, but more specifically service supply chain management. In doing this, the generic supply chain management definition will be considered with the changes or adaption to services.

One definition of the supply chain management is given as, the management of information, processes, goods and funds from the earliest supplier to the ultimate customer, including disposal.

This definition can be adjusted to services, without any modification. But it is only applicable for a certain type of services, these are typically services related to retail and repair (Ellram et al., 2004). Although, this definition does not easily fit services like professional services where there is no transfer of goods per se. It is the transfer of the service utilizing the supplier's service, assets and staff. In essence, buying a service represents the transfer of the service supplier's capacity to its customer in the form of a service. In broadening the definition of supply chain management, Ellram et al. (2004:25) propose this definition for the service supply chain: "Supply chain management is the management of information, processes, capacity, service performance and funds from the earliest supplier to the ultimate customer".

Baltacioglu, Ada, Kaplan, Yurt, and Kaplan (2007) find that Ellram et al.'s (2004) definition does not adequately describe a service supply chain. Baltacioglu et al. (2007:112) propose an alternative definition: "The service supply chain is the network of suppliers, service providers, consumers and other supporting units that perform the functions and transactions of resources required to produce services; and the delivery of these services to customers. Following the original definition acknowledged in the Global Supply Chain Forum and our definition of supply chains, we propose that: Service supply chain management is the management of information, processes, resources and service performances from the earliest supplier to the ultimate customer".

Balticioglu et al. (2007) thus take Ellram et al.'s (2004) view of capacity, which is derived from the approach of professional services, and replace this with the concept of resources. This is important as it underlines the topic based on what is modelled. The context of the modelling, as well as the chosen proxy to inventory or product, changes how we model the supply chain.

Maull et al. (2012:73) describe that, "service supply chains refer to the supply chain of goods and services that support the realization of the service; it is the supply chain for services, not of services". This definition is important as it allows the service supply chain to include the flow of goods. It's essential to note, there are processes that are pure services, or processes that are pure goods. We also find many that are a mixture of goods and services, working together to produce a final product to the customer, which may be a good or a service. These different models will be described under the section of service supply chain models.

He, Ho and Xu (2010:194) state that service supply chain definitions should not neglect the concept of value from the definitions. "As a rising research topic over the past few years, SSC has not yet had an exact and uniform definition. Some of the existing definitions are the expansion of the traditional product-centric supply chain or the ones based on the supply and demand process while some others are about the descriptions of service product outsourcing chains, and so on. However, they ignored the core idea, 'how to create service value for the customer and supply chain system'."

Kathawala and Abdou (2003:145) provide the definition as, "the supply chain management for the services industry is the ability of the company/firm to get closer to the customer by improving its supply chain channels. The services supply chain will include responsiveness, efficiency, and controlling."

Thus far, this section has focused on definitions of the service supply chain, which has primarily given the components of the supply chain. A further area of the definition should include the overall scope. Where does the supply chain begin and where does it end? Each basic supply chain is a "chain" of a source, make and deliver execution process. Planning sits on top of these links and manages them (Huan, Sheoran and Wang, 2004). This is in line with the basic building blocks of the SCOR model.

Supply chains can be modelled in three degrees of complexity:

1) A 'direct supply chain,'
2) An 'extended supply chain,' and
3) An 'ultimate supply chain'.

A minimum number of three members are required to form a supply chain namely, the supplier, the organisation and the customer. This minimum number forms the direct supply chain (Zuñiga, Wuest, and Thoben, 2013).

A further consideration of supply chain management is the evolution of, or progression, in supply chain management. A supply chain is the context in which goods, services and information flow from the earliest supplier to the end user. This has been expanded to include the flow in the opposite direction, which is known as reverse logistics. In this context, supply chain management is the effective and efficient management of this structure and the relationships between parties taking place in the chain. Supply chain management is the integration of the key business processes: From end user, through the original suppliers of products, services and information - that add value for customers and other stakeholders (Baltacioglu et al., 2007).

Despite the popularity of supply chain management, the concept still has some problematic areas. The first problem is that the concept may differ, based on how the supply chain is framed and approached. This will be illustrated further when considering the different models to service supply chain management alone. Secondly, the nature of the supply chain is not the same across all industries. As an example, in this chapter reference was made to certain definitions of the service supply chain models that fit certain industries, but are not sufficient for professional services, as described by Baltacioglu et al. (2007).

This section has provided a few definitions for Service Supply Chains and elaborated on the scope of a supply chain in its most basic form to more complex forms. It is important to note that the definitions are similar but tend to differ based on the type of service being modelled. Some services are considered relevant to certain traditional SCM definitions without any modification. The definitions also give indicators to the dimensions of supply chain management and more specifically, service supply chain management. These dimensions must be contained in a model of SSCM as well as areas that must clearly be described and elaborated upon. These definitions will be discussed further during the review of the different models of the Service Supply Chain.

2.1.4 Why study Service Supply Chain?

As part of the study of service supply chains, the question of why we need to model service supply chains becomes relevant. Two topics are important in studying the need to look at Service Supply Chains:

1) It provides the overall motivation of considering the topic of services and
2) it provides the goals of what we would like to achieve in our modelling of a service supply chain, which will in turn shape what we model to achieve this objective.

Supply chains have become important as companies try and find new ways to compete. With the increase in importance of the service sector, attention is being directed to help understand and improve service supply chains (Sengupta, Heiser, and Cook, 2006). In today's environment, supply chains are competing with one another and not companies (Georgise, Thoben, and Seifert, 2012).

This growth in services has resulted in a need for research on services and, more specifically, service supply chains. Service supply chains are becoming a topic requiring more research, as there is a transition from the industrial economy to the service economy (He, Ho, and Xu, 2010). Baltacioglu et al. (2007) go further to motivate the research into services supply chain, as they state effective supply chain management must be considered as important as it has been in the manufacturing industry. Even though the service supply chain concept is new, it should be adapted to the service business - taking the unique characteristics of services into account.

He et al. (2010) concluded that various models of service supply chain management exist in various guises. These include services outsourcing, Everything as a Service (EaaS), Web 2.0 and mashup. A large amount of literature already exists around outsourcing in general and specifically for services. Thus, service supply chains that are already in practice need to be modelled.

In addition to the motivation of the growing service sector, together with the challenge for finding new areas for competitive advantages, supply chain management itself has specific benefits and objectives that hope to be achieved. The importance of supply chain management is linked to the benefits it can bring. Firms enjoy the benefits of reduced costs, increased revenue, improved customer satisfaction and improvements in the service delivery quality. The modelling and managing of a supply chain improves the sharing of information and in so doing creates better alignment across firms. It also has the benefit that the effective management leads to better responses to changing customers' needs and demands (Baltacioglu et al., 2007).

Brugess and Singh (2006) give the following benefits for taking a supply chain management approach:

1) Supply chain management gives firms the ability to improve their financial performance, given the increased competition that exists within the industry between companies.
2) The evolution and restructuring of industries, because of supply chain management, has naturally led to a focus on the wider supply chain.
3) Supply chain management is a natural response to globalisation and the deregulation of markets.

4) The interdependencies between firms have increased with the implementation of techniques like lean and just in time (JIT).

According to Giannakis (2011), when considering services, companies specifically find the benefits of viewing the service supply chain as:

1) Coordination of processes: the complexity of providing services across multiple companies and multiple departments places a greater need on the co-ordination across services than even manufacturing.
2) Improved performance through process integration: by viewing services as part of the supply chain, an end-to-end view can be taken in the improvement of the process and the identification of weaknesses in the process.
3) Improvement of the customer interface: the modelling of the supply chain can improve the service delivery, flow of information and overall quality of the service from the service provider firms to the customer; given that customer interaction is regarded as higher in the service interaction.

Georgise, Thoben, and Seifert (2012) highlight the business' need to quantify both the efficiency and effectiveness of service operations and make their impact on customers' overall performance transparent.

This section has viewed the rationale for studying service supply chain management. This was done viewing the benefits considered for supply chains in general but also refers to service supply chains specifically.

2.2 Characteristics and Classification of Services

The previous sections studied the evolution of services, the differences between services and manufacturing, and explored the concept of service supply chain management. This next section will consider the area of services themselves.

The preceding section already started considering the nature of services, by comparing it to manufacturing. However, it is also important to find a definition of services and to describe the characteristics of services themselves.

More importantly, the perspective of this study is to understand services in a context of the classification of services. Can services be described as one homogenous entity, or can we distinguish between a number of services into different categories? Furthermore, services themselves are changing. The services sector is undergoing a revolutionary change, it is considered a very broad concept. The changing demands of customers are resulting in the service industry becoming broader (Lovelock and Wirtz, 2004).

2.2.1 Diverse Nature of Services

We generally talk about services as a single concept and assume that all services fall into one category. This is different from other industries, such as manufacturing. Seth, Deshmukh, and Vrat

(2006) state that the word 'service' has a great richness and diversity in meaning. This leads to considerable ambiguity when the concept is used in the management literature where, in its most basic sense, it can mean an industry, an output or offering, or a process. Within the service process, service may further indicate core service delivery, interpersonal interaction, performance in a wider sense of skill, or the customer's experience of service. Thus, services themselves vary greatly in what we are referring to. It could even be that some services are closer to manufacturing than to other services, such as professional services.

Sengupta, Heiser, and Cook (2006) support this view as they comment on the general, broad classification of manufacturing and services. However, they claim that research is required in the analysis of services themselves and the classification of these services, within the broader grouping of a service.

The diverse nature of services and service systems imply that the different stakeholders view services from diverse contexts. And diverse sets of knowledge are required in delivering the service (Spohrer, Maglio, Bailey, and Gruhl, 2007). The theory explaining services and service systems must be able to explain services as they occur in everyday life.

Finding an overall definition for services is important. It may also be that services may be defined differently depending on the context, use or type of service. The approach to managing the service will differ depending on the way in which the service is defined (Sampson, 2000).

One approach to classifying services is through the characteristics of the service. Here, intangibility of the service plays a major role in defining the service. The intangibility of services is a very popular view within the study of services (Sampson, 2000). Akkerman and Vos (2003) attribute characteristics to services. Pure services are:

1) Intangible,
2) Labour intensive,
3) Heterogeneous,
4) Cannot be stored and transported because production and consumption occur simultaneously,
5) Have a high level of customer influence, and
6) Have a quality dimension that often is difficult to judge.

The implication of viewing the service as an intangible product introduces complexities when considering a service supply chain (Sampson, 2000):

1) Intangibles may be difficult to store. By their nature, intangibles cannot be stored and are consumed as they are produced.
2) It can be difficult to account for intangibles. Their being sold does not deplete most intangibles – after the intangible is delivered; the service provider often continues to have the same capacity to deliver the intangible. An example is knowledge; this intangible can be re-used and resold many times over.

3) It could be difficult to identify the supplier of intangibles. It is also difficult to trace the origin of the knowledge, which implies that the supply chain of such an intangible is difficult to manage.

Even in the popular notion that services are intangible, Sampson (2000) comments that the perspective of intangibility is not adequate for defining services. When viewing the definition of intangibility, it is often referred to as not being capable of being perceived by the senses, especially touch. In the case of services, the service must somehow be perceived and in many services, they will be perceived through some form of the senses. The challenge again lies in the fact that it cannot be seen as a rule to services, given the diverse nature of service.

Expanding on the concepts above, of the interaction of the customer within the service process, Svensson (2004) provides distinctive features of services that include:

1) Services are intangible and heterogeneous;
2) Their production, distribution and consumption are simultaneous processes;
3) They are essentially activities or processes;
4) They represent a core value that is created in buyer-seller interactions;
5) Customers participate in their production;
6) They cannot be kept in stock; and
7) There is no transfer of ownership.

Here, the focus is on the interaction and the interactive nature of services. The implication of this is that the nature of services means they are produced, distributed and consumed during the interaction between the service provider and the service receiver. The implication on service quality through a chain of interactions is, however, not well understood.

Other definitions of services have been set forth, which are considerably more definitive than the intangibility supposition (Samson, 2000). Some examples include:

1) A service is a personal performance;
2) A service is a product which is a process;
3) Services are processes involving customer contact and
4) A service is a deed, act or performance.

These provide interesting perspectives but do not assist in classifying services. The examples are too narrow to include all services, or too broad to be of much use in classifying services.

A further approach to classifying services is through defining them into categories based on dimensions that have been observed. Armistead and Clark (1994) take the approach of classifying services according to the dimensions of the level of standardisation, together with the point where the value is added. This model is proposed in the context of providing strategies in coping with capacity management for the specific type of service. This proposed C-F-B Operational Focus model is shown in Figure 5. The model describes dimensions of highly standardised or customised services, as opposed to services where value is added from the back office or value is added from the front office.

	Added Value Back Room	Added Value Front Office
Customize	C-[F-B] Front to back room driven	[C-F]-B Client interaction driven
Standardized	C-F-[B] Operations driven	[C-F-B] Customer participation driven
	Low Customer Contact	High Customer Contact

Figure 5: Operation Focus for Service Delivery (Armistead et al., 1994:13)

In considering the four resulting quadrants, Armistead et al. (1994) describe the various blocks as:

1) High customization plus added value in the front office [C-F] –B: Here the focus is on the interaction between the front line provider of service and the customer. A typical example is professional services. The back room delivers support services to the front office and can frustrate the front office if it does not deliver timeously, but the interaction to the customer is through the front office, with no contact to the back room.

2) High customization plus added value in the back room C-[F-B]: Examples of this scenario are market research or repair operations. The operation is centred on obtaining the correct information, which is then relayed to the back room with feedback and further clarification. This then flows back from the back room to the front office to clarify with the customer. The front office acts as a go-between to the customer. The front office must be aware of the state of the back room in order to manage the expectations of the customer of the service. The front office must ensure the customer satisfaction through balancing the customers' expectations and the capability and capacity of the back room. Interactions with the customer are typically at the beginning and end of the process.

3) High standardization plus added value in the back room C-F – [B]: Here, the operational focus is on the back room. The focus in the back room will most likely be towards efficiency. Examples of this dimension are transport operations or retail banking. The role of the front office is to make a standard service seem specific to the customer through customer-care techniques, in essence conditioning the customer to expect a standard service.

4) High standardization plus added value front office [C-F-B]: The situation is one of participation by the customer in a standard service. The participation may be in a self-service capacity or it may be to play in a service involving groups of customers. Here it is important to ensure that the front office and back room are well co-ordinated, to ensure that the customer can interact and play an active role in the process and not be frustrated during the process.

For each of these cases, Armistead and Clark (1994) propose approaches to managing the capacity for the type of service. As an example, Armistead et al. (1994) provide the following guidelines with regards to the Operations driven, C-F- [B]: In this dimension the strategies for coping with constrained capacity include: a) Downgrading the service to the minimum characteristics that the client needs from the service; b) Relay on the relationship between the client and the front office, to manage the customer expectation during periods of capacity problems; and c) Prioritizing the work.

This model becomes useful in classifying services in terms of its level of industrialisation. Professional services would typically fall into the category of [C-F] – B, where the most focus is on a customised service and majority of the work is being done in the front office with little back-office support. In contrast, services resembling the classic understanding of manufacturing characteristics can be associated with the C-F-[B] quadrant, where the customisation is low and the back office plays a large role. These types of services should be considered for the applicability of supply chain models, like the SCOR model for its suitability. This model is thus useful in our classification of services.

A further classification of services is in relation to a product. Here, services are classified either in support, as an extension of a product or as a pure service. This view is discussed further when describing various models to service supply chain management.

Schmenner's (as cited in Sampson and Spring, (2012)) Service Process matrix introduces a different classification to services. Schmenner's matrix (shown in Figure 6) divides service businesses into four categories according to two dimensions: 1) degree of interaction and customization, and 2) degree of labour intensity.

Degree of Labor	Degree of Interaction and Customization	
	Low	High
Low	Service Factory (e.g., airlines)	Service Shop (e.g., auto repair)
High	Mass Service (e.g., schools)	Professional Service (e.g., architects)

Figure 6: Schmenners Service Process Matrix (Sampson and Spring, 2012)

The classification of services in Schmenner's model makes services with low customization and interaction, most analogous to processes of manufacturing, and to our definition of industrialised services. Sampson et al. (2012) go further to apply the role of the customer in the processes in each of the four quadrants. The model of Service Factories shows a quadrant where the client takes on the role of Inventory or Product. As a result, this model is the most analogous to our concept of an industrialised service. The model of low labour also provides a better description of services more suited to manufacturing than high labour, where the client may start to play a role in the manufacturing process. Figure 7 shows the various roles of the customer in the service categories.

In Service Factories	In service Shops
Inventory Product	Component supplier Inventory Production Manager Quality Assurance
In Mass Services	**In Professional Services**
Labor Component-supplier Production manager Product Inventory Quality Assurance	Component-supplier Labor Product Production manager Inventory Quality Assurance

Figure 7: Customer Roles in Service-Process Matrix (Sampson et al, 2012)

We also see the dimension of professional services, which is most likely the process that will be least suited to being modelled through constructs like supply chain management. This study will focus more on services described in the Service Factory. The classification of services provided in this section aids in the distinction of services.

This section illustrated various models of classifying services. It also highlighted models that fit the concept of industrialised services and briefly described the characteristics of these services. This research will focus on these specific classes of service and will rely on these characteristics to adapt the supply chain models to be suited to these services.

2.2.2 Outsourcing

Outsourcing does not provide a classification of services per se, but outsourcing is a trend very popular in services. As part of the outsourcing of services, the characteristics and traits of services can be better observed. There is also a trend concerning the outsourcing of services, services that were considered to be highly customised and bespoke, now appear more standardised and structured (Flecker and Meil, 2010). This points to a change in the nature of the services as outsourcing is implemented. Outsourcing is useful in analysing. It is a form of creating a service supply chain where some element of the service is removed from the primary company. It may not always be that it forms a chain toward the end customer. As in the case of payroll outsourcing, some outsourcing would be the movement of services that support the primary provider service. It is, however, useful to understand the characteristics of services outsourced as they give an indication of the characteristics to expect in service supply chains.

There is a lot of literature captured around services in the topic of outsourcing. It is thus useful to consider outsourcing as part of the understanding of the nature of services.

Outsourcing has progressed from moving tactical work (greatly associated to manufacturing), to the strategic approach to moving services; more specifically, services that are seen as core to the company. This move has started with the Information Technology (IT) function, with contractors like EDS or Andersen Consulting being able to take over a company's entire IT function (Allen and Chandrashekar, 2000).

In classifying services, Spohrer, Maglio, Bailey, and Gruhl (2007) define service systems as a value-coproduction configuration of people, technology, other internal and external service systems, and shared information. This emphasises the fact that service systems have internal structure (intra-entity services) and external structure (inter-entity services) in which participants coproduce value directly or indirectly with other service systems. Spohrer et al. (2007) describe services as i) tell me ii) show me, iii) help me, and iv) do-it-for-me types of services. Tell-me-services are the reduction of the application to a set of instructions. Show me, help me, and do-it-for-me have increasing levels of complexity for services, with IT Outsourcing being an example of do-it-for-me. This classification of services provides interesting levels of progression. It could be argued that the ultimate level of do-it-for-me types of service is most applicable to be modelled in a supply chain. However, in this case, we still have do-it-for-me services, which are highly customised, making manufacturing models less appropriate.

Services, defined as the application of competences for the benefit of another, meaning that service is a kind of action, performance, or promise that is exchanged for value between provider and client (Spohrer, Maglio, Bailey, and Gruhl, 2007).

In further expanding on the nature of services, as they apply from an outsourcing perspective, Spohrer et al. (2007) define three key types of shared information: language, laws and measures. Provisioning sophisticated service and maintaining complex service systems requires laws and contract. Prices are one type of measurement of the value of service, as exchanged within or between service systems.

Sphorer et al. (2007) highlight three parts to the theory of services:

1) Science – Description of services and their evolution. It is not uncommon to refer to the decomposition of services when automating or replacing some portions of work with technology, or when outsourcing work. It has already been stated that work becomes more formal and structured when outsourced.
2) Management – How to invest to improve service systems. Effective management of services systems is enabled through the understanding of service system improvements and failures.
3) Engineering – How to invest new technologies that improve the scaling of service systems. There are three types of resources that make up all services namely, people, technology and shared information. With people, higher demand and level of education required to deliver the service result in more expensive services. Technology resources can be likened to physical material, where an increase in units usually leads to a decrease in unit rates based on economies of scale. Service systems can thus make better use of scale if it has integrated technology into its delivery. Informational resources enjoy incredible scale efficiency because of the small

incremental cost of duplicating them. Creating the next unit of an informational resource has virtually zero cost.

This model describing services is interesting, as it describes different types of services, specifically for outsourcing and support, but it is not useful in classifying services in terms of the dimensions of "Industrialization" as we have defined industrialised services. The model is more useful in terms of the transfer of knowledge and describing various services where the "proxy" to inventory is the transfer of knowledge, which is described further in a later section. The views of this model do provide insights into the nature of services, especially in the method of interaction between companies.

Outsourcing in general gives dimensions and concepts when considering the overall service supply chain, as it is in essence a form of the service supply chain. Outsourcing is studied as it has a greater amount of research and literature associated to the practice, which is useful when considering service supply chain management.

2.2.3 Services and IT

IT, within the context of services, is generally used in two contexts. The first is in the context of a support or aid, where IT has an impact on the improvement of the overall supply chain. The second is to view IT as a service in its own right. This section will consider IT as a service in its own right to further expand the understanding of services and the changing nature of services.

Many references in literature, as well as in this study, relate to the IT industry and more specifically the IT services industry. The previous section considered outsourcing as a means to understand service and the service supply chain. The IT environment is one of the largest areas that has gone through the processes of outsourcing and also the optimisation with outsourcing. IT is going through a major transformation and is seeking the benefits of improving, by looking wider than a single company (as we saw the drive in manufacturing). Other industries have gone through years of improvement and globalization. This approach to globalisation in IT was largely fuelled by the Y2K problem (Grimme and Kreutter, 2014). The Y2K problem drove the need to have large teams of cheap programming skills available at very short notice. This drove work to regions like India and central Europe. This provided low cost alternatives to local providers, who were still struggling with a high-wage legacy workforce. Furthermore, this move drove the trend towards more standardized products and improved technological flexibility.

Abolhassan (2014) identifies the industrial revolution in the production and service processes as the challenge facing IT providers and IT service organisations. The manufacturing industry can serve as a model of the transition from bespoke artisan based products, to standardised production factories that deliver high standards of service and quality. These IT companies will only be able to survive if they are able to make this leap - as was experienced in the manufacturing industry. It is this drive and change in the environment that sees a change in the nature of service, specifically in IT and which makes it applicable for this study.

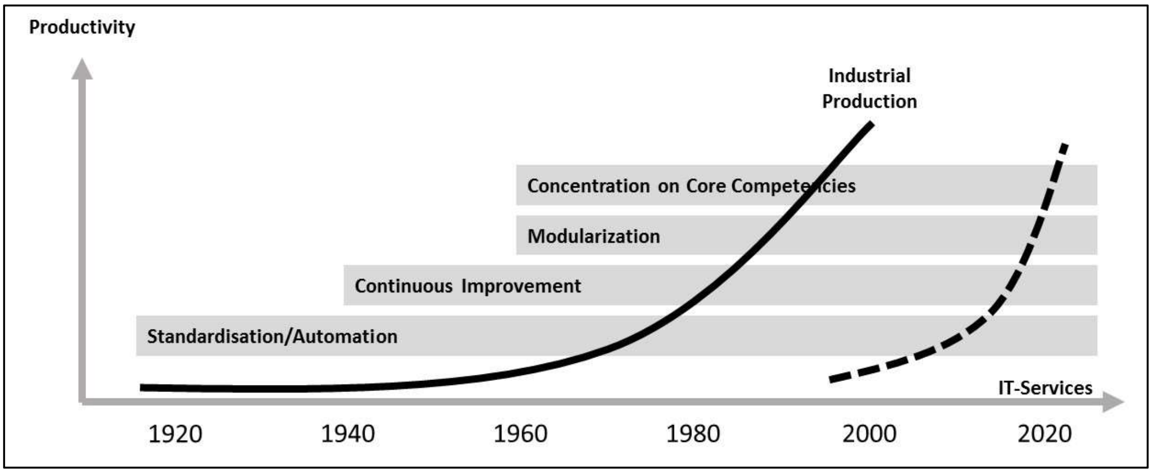

Figure 8: The evolution of IT Industrialisation (Abolhassan, 2014)

A concept that has been used to define this change in the IT services industry, towards an industry more likened to manufacturing, is IT industrialisation. Abolhassan (2014) describes the Industrialisation of IT as, the application of tools and techniques traditionally associated to the manufacturing industry to the services sector. At first, the concept may be very vague as services are difficult to define or characterise. However, when one considers the evolution of IT services, the application of these manufacturing techniques become more relevant. This evolution of manufacturing and IT services is shown in Figure 8. It illustrates the similar phases the two industries have gone through; all be it not as advanced in the case of IT services.

It is this change in the IT services and services in general, that forms the base of this study. What we are seeing is that certain types of services in general are becoming more "industrialised". In these processes, services are moving into more standardised forms. There is a shift from services being more likened to the early stages of manufacturing - highly customised and bespoke. Thus, not only in addition to different types of services, service themselves are evolving. It can also be argued that services are evolving to tend towards greater standardisation, as is being observed in the IT industry.

In relation to IT services and the outsourcing of services, the trend has been to focus on costs using global value chains. The focus on costs is now seen as a qualifying factor in the supply chain and no longer a differentiator. The differentiation in the global value chain of IT will in future be through a differentiation in quality (Abolhassan, 2014). Quality is thus an important focus and outcome in the management of the supply chain in IT services.

A further area that has seen development or evolution in IT is the standardisation and modularisation of IT services. This has resulted in IT solutions becoming mass produced and easily producible thereby, resulting in a commoditisation of IT. Confronting IT service providers with the need to steer their way through the opposing forces of customer expectations, reliable operations, and dwindling profit margins. The reasons are simple: When products and services become cheaper and more readily available, because of standardisation and automation, they turn into a commodity and lose their lustre in the eyes of the customer (Abolhassan, 2014).

This section described IT services in the context of classifying overall services. Emphasis was placed on a specific type of service that is highly standardised and modularised. Further it was illustrated that these services are becoming more common as the IT industry is moving further toward commoditisation. If there is any doubt about this, the concepts like cloud services with Infrastructure as a Service, Platform as a Service and Software as a Service are clear examples of this standardisation. This section also argued that the use of manufacturing practices might be appropriate when approaching these maturing standardised services.

2.3 Service Supply Chain Models

As with the concept of services, there are many interpretations to the concept of service supply chain management. This section will show various approaches to service supply chains in addition to the definition of service supply chain management, which was given in section 2.1.3.

Concepts reviewed in this section will analyse service supply chains and the impact that the manufacturing industry has had in defining the service supply chain. The different perspectives include viewing service supply chains as an extension of the product supply chain- the balance taking a goods-centred view of the supply chain as opposed to a service-centred view, viewing the service supply chain from the provider perspective; and viewing the service supply chain from the customer perspective.

This is then followed by a discussion of the various models and the approach that will be adopted for this study.

2.3.1 Service Supply Chain as New Concept

The transition in the global economy from an industrial economy to a service economy is forcing the topic of service supply chain management becoming a greater priority for researchers (He et al., 2010). Service supply chain management focuses on operations management at its core, which is concerned with delivering services to customers as well as managing the process that delivers the services while implementing continuous improvement.

Effective supply chain management is as essential in the services industry, as it is in the manufacturing industry. The supply chain concept, which is still relatively new, should thus be adapted to the services industry while taking into account the unique nature of services (Baltacioglu et al., 2007).

Managing the service supply chain has been seen in different forms within services. Concepts like service outsourcing, service mash-up, Everything as a Service (EaaS) and Web 2.0 are examples of the concepts of service supply chain management becoming more popular within industry (He et al., 2010). The challenge in this is that there is no uniform definition for service supply chain management. Some of the existing definitions simply build on the existing definitions of the traditional supply chain management, founded in manufacturing. While others describe the concept in terms of service, outsourcing chains (He et al., 2010).

Little work has been done to date in creating a framework for managing and understanding the service supply chain. This applies to both considering the supply chain from the perspective of the service provider and the buyer of services. (Ellram et al., 2004).

It is with these challenges in mind that the various approaches to supply chain management, as found in literature, are considered in the following sections.

2.3.2 Service Supply Chain and the Impact of Manufacturing

Studies on supply chain management are generally focused on the supply chains of the manufacturing industry (Maull et al., 2012). When considering service supply chain management, one cannot neglect the impact that the manufacturing focus has on the works of service supply chain management.

There are two schools of thought around the use of manufacturing models, as it relates to services, and specifically service supply chain management. The one approach is to consider manufacturing practices and apply them to services. The other approach is to consider the application of manufacturing models to service as inappropriate.

In arguing for the use of manufacturing models for the application to services, manufacturing practices were applied to the insurance business through the application of the principles of lean manufacturing. This showed that the manufacturing techniques are applicable to services (Ellram et al., 2004).

Ellram et al. (2004) consider the reason for performing supply chain management. The question that supply chain management is trying to address is how can we design and manage a supply chain, controlling its assets and uncertainties to best meet the needs of the customers in a cost-effective manner? The rationale and underlying issues to achieving this goal are the same for services and manufacturing and as such the techniques available to manufacturing may be applied to services.

The alternative view is supported by manufacturing-centric literature based around supply chain management and the general acceptance of these models may in fact be an obstacle to the development of research and models in service supply chains (Baltacioglu et al., 2007). A further deterrent to the development of service supply chains may be the complexity of service operations that act as a deterrent to developing models in service supply chains.

Baltacioglu et al. (2007) summarise the distinguishing factors between service and manufacturing and how they change the structure of the service supply chain:

1) The greatest difference between manufacturing and services is the intangible nature of services.
2) In services, the customer must be present as part of the delivery of the service. This is referred to as simultaneity.
3) Services are not easily standardised. This is referred to as heterogeneity.
4) Services cannot be stored and kept in stock. If a service is not consumed when available, it will be lost. This is referred to as the perishability of services.

5) Services are seen as labour intensive. This results in a greater dependency of human interactions in the delivery of the service, which increases the complexity of the services.

Maull et al. (2012) describe further differences between services and manufacturing. Services are difficult to visualise and measure - making service supply chains challenging to manage. These differences between services and manufacturing require further research into the nature of service supply chains that move away from the conventional manufacturing approach.

This section considered the use of manufacturing practices as it relates to service supply chains and the complexities associated to this. Additionally, it described two opposing views, but in studying these views and the examples given, it can be considered that manufacturing practices can be applied where the service is highly standardised. While for customised services where there is high human involvement and initiative, like consulting, these models are less appropriate. The human involvement and (apparent complexity) is decreasing with the standardisation and evolution of services, specifically the role of information technology.

2.3.3 Service Supply Chain as extension of Product Supply Chain

The focus of considering service supply chain management from the perspective of manufacturing, results in a view from the perspective of the product. This is reflected in more recent literature that refer to product service systems (PSSs), defined as a marketable set of products and services capable of jointly fulfilling a user's needs (Maull et al., 2012). Three types of PSSs are identified:

1) Services such as advice and consultancy add extra services to the product referred to as Product-orientated services;
2) Use-orientated services, where the provider owns the asset and provides a service through leasing it to the customer;
3) A results-orientated service where there is often no predetermined product, and the service provider uses their resources to provide service outcome.

This change of focus from a product (value-in-exchange) to a service (value-in-use) focus has been considered by an increasing amount of literature. This literature suggests that as companies moved from a product to a service focus, the supply chains of these companies became more vertically integrated. The objective used to be the sales of knowledge and moved away from a pure cost focus towards a focus on the customers' needs and responsiveness. The outcomes of PSS still relate to companies that deal with products. Maull et al. (2012) pose the question, "Is there relevance to extend the supply chain models to the wider service environment?"

The view that the service supply chain is not separate from the traditional supply chain, rather contains additional service elements or steps, may make the use of the phrase service supply chain inappropriate. It might be more appropriate to refer to "service elements of supply chains" (Sampson and Spring, 2012).

The development of the service industry has resulted in the blurring of the boundaries between the supply chains of goods and services. Thereby resulting in scenarios where supply chain models, which have been very successful for the manufacturing industry, are applied to these wider services (Peng, Tong, and Li, 2009). Research into these increased supply chains can be categorised into two groups:

1) In the first definition, service supply chain is interpreted as associated service activities in traditional supply chain,
2) The second view is that service supply chain model is the application of traditional supply chain theory in the service sector.

Wang, Wallace, Shen, and Choi (2015) define two types of supply chain systems, namely the Service Only Supply Chains (SOSCs) and the Product Service Supply Chains (PSSCs).

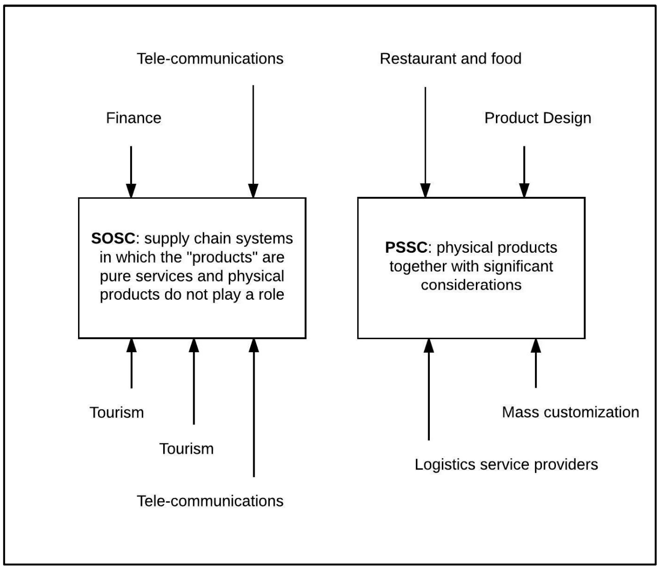

Figure 9: Service Supply Chain Examples (Wang, Wallace, Shen, and Choi, 2015)

This section has shown the views of two types of supply chains as it relates to services. of the first is viewing the service supply chain as an extension of the product supply chain, to include services. Secondly, to view service supply chains as the provision of pure services. The next section will expand on this concept with the view that not all supply chains should be measured in the flow of the physical product, but rather the value the supply chain adds - be it through product or service.

2.3.4 From Goods Dominant Logic to Service Dominant Logic

After considering Service Supply Chain Management based on various definitions, it is useful to consider various perspectives and their subsequent models related to Service Supply Chain Management. The following three sections will describe three perspectives on Service Supply Chain Management followed by a section discussing the different models.

Lusch, Vargo, and O'Brien (2007) explain the evolution in marketing, moving from a point where customers are marketed to, up to the point where the customer is an active participant in the service that the customer is consuming (refer to Figure 10).

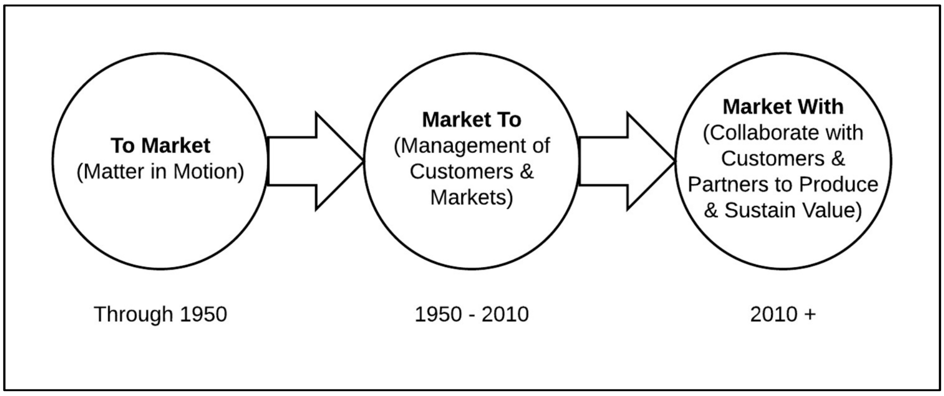

Figure 10: The Evolution of Marketing (Lusch et al., 2007)

Lusch et al. (2007) take a view of positioning services and manufacturing relative to one another referring to Goods Dominant Logic and Service Dominant Logic. Goods Dominant Logic view units of output as the central components of exchange; it considers the physical product as the output. Service Dominant logic superordinate's service (the process of providing benefit) to products (units of output that are sometimes used in the process). Service-dominant logic is grounded in nine foundational premises, eight of which were initially elaborated in Vargo and Lusch (2004) and the ninth in Vargo and Lusch (2006). These are reproduced in Table 2 (Lusch et al., 2007). Lusch et al. (2007) describe Service Dominant Logic in the context that goods are a subset of the overall service. And that even within manufacturing, the value lies not in the good that the end customer receives, but rather in the value the customer receives from the good. Hence, the service supersedes the good or manufacturing. "In SDL, customers are recognized as active participants in relational exchanges and coproduction; goods are an appliance for the delivery of the service and value is only determined by the customer according to value in use" (Maull et al., 2012).

These concepts are relevant as, depending on the approach to modelling the supply chain; one comes to a different result of the modelling simply through the context with which one models the service or manufacturing. The principles that Vargo et al. (2007) used to base this approach on are shown in Table 2.

Table 2: Rationale for Service Dominant Logic (Lusch et al., 2007)

Foundational premise	**Rationale**
FP1. The application of specialized skills and knowledge is the fundamental unit of exchange	Service – applied knowledge for another party's benefit – is exchanged for service
FP2. Indirect exchange masks the fundamental unit of exchange	Micro-specialization, organizations, networks, goods, and money obscure the service-for-service nature of exchange
FP3. Goods are distribution mechanisms for service provision	"Activities render service; things render service" (Gummesson 1995)—goods are appliances
FP4. Knowledge is the fundamental source of competitive advantage	Operant resources, especially "know-how," are the essential component of differentiation
FP5. All economies are service economies	Service is only now becoming more apparent with increased specialization and outsourcing; it has always been what is exchanged
FP6. The customer is always a co-creator of value	There is no value until an offering is used—experience and perception are essential to value determination
FP7. The enterprise can only make value propositions	Since value is always co-created with and determined by the customer (value-in-use), it cannot be embedded in the manufacturing process
FP8. A service-centered view is customer oriented and relational	Operant resources being used for the benefit of the customer inherently places the customer in the center of value creation and therefore implies relationship
FP9. Organizations exist to integrate and transform micro-specialized competences into complex services that are demanded in the marketplace	The organization exist to serve society and themselves through the integration and application of resources

Maull et al. (2012) summarize the contributions made by Lusch et al. (2007) in their discussion of Service Dominant Logic in five main implications and have highlighted those items that are most closely related to this research:

1) Integrating the customer into marketing and supply chain management.
2) The systemic nature of value creation. Co-creation involves complex networks rather than linear supply chains and therefor like any complex system has systemic interventions and effects.
3) Market sensing and organizational learning. How do organizations go about the second order concepts of sensing the market, learning and adapting?
4) Governance issues with value networks. Vargo and Lusch (2007) compare SDL to a traditional perspective on value offerings that they call goods-dominant logic (GDL), which is when firms add value-making products, with the value being manifested in exchange, not in use, as it is the case under SDL.

5) Innovation. With SDL and value networks, product innovation has become open. So how do you bring suppliers and customers into the product design process? How do customers motivate competing suppliers to collaborate? And what are the issues surrounding intellectual property?"

This introduces a shift in how supply chains are modelled. The SDL leads more to the involvement of the customer within supply chain management and specifically service supply chain management. One consistent conclusion that researchers come to is that the customer plays a significant role in service supply chains, as opposed to considering the supply chain from a GDL perspective. Examples for this observation:

1) When a client brings an appliance for repair, the client actively has to transport the device and collect it,
2) In consulting services, the inputs and the co creation of proposals in intellectual property or normally done together with the client,
3) In project management services, the project management is done with very direct involvement of the client, etc.

There are many similar examples where the client plays a more prominent role when it relates to services as opposed to manufacturing. This has many implications on the nature of how the supply chain is modelled. "They identified that as a company transitioned from a product to a service focus, there was a move from a vertically integrated supply chain to one which focused on brokering knowledge and from a focus on cost, to a focus on responsiveness to the needs of the external customer" (Maull et al., 2012).

Considering services in a GDL approach makes the topic of considering the differences between services and manufacturing, on an operational level, very important. Maull et al. (2012) conducted an empirical study of manufacturing and service companies and found that there were different factors that were more relevant depending on the industry being studied. As examples: when considering operational and financial performance as the independent variables, manufacturing showed the dependent variables to be the hedging strategy and long-term relationships; as opposed to service companies who had information sharing, customisation and the distribution network structure as the dependent variables. This leads them to the conclusion that there are large differences between the modelling of services and manufacturing, with the core element in manufacturing being the product, and the core element in services being activity and customer involvement.

Maull et al. (2012) conclude from the work of Lusch et al. (2007) that little attention has been paid to the customer viewpoint with reference to service supply chains. Much of the literature takes the view of the service provider and regardless of the customer playing an active or passive role. The focus is on what this means for the service provider, rather than the impact and influence of the customer.

Service Dominant Logic introduces services as a superset of goods. This allows more contextual elements to be considered in the overall supply chain and not just the flow of goods. The focus however, is not to model and optimise an end-to-end flow, as that is seen as too operational in the Service Dominant Logic model. Service Dominant Logic allows various parties to be considered in the entire value creating process especially focusing on the customer and the co creation together with the customer. Service Dominant Logic is important to consider as it shows the trend towards services, although it is not seen as something to optimise as it is with manufacturing. It further emphasises the role of the customer when considering the services in the overall supply chain.

2.3.5 Service Provider Perspective

In defining the supply chain, Ellram (2004) starts with the definition of Supply Chain management as contained in the manufacturing context, then expands this towards the Service Supply Chain. This definition then leads to a service provider centric view of the Service Supply Chain. This has been discussed in section 2.1.3. The supplier provides the service to the service provider or directly to the service provider's customer. The services provided by the service provider contribute directly to the core service of the supply chain. In other words, the service supplied by the supplier should constitute some part of the core service.

Baltacioglu et al., (2007) put this view into a context more relevant in the view of service provider and supplier, and shows how the various dimensions of the Service Supply Chain apply across the Supply Chain (refer to Figure 11).

There are activities that are essential to the Service Supply Chain. These activities may exist across the entire supply chain; while others may only be applicable to certain sections of the supply chain when taking the perspective of the service provider (Baltacioglu et al., 2007). They (Baltacioglu et al., 2007) identify these activities as: demand management; capacity and resource management; customer relationship management; supplier relationship management; order process management; service performance management; and information and technology management. This is illustrated in Figure 11.

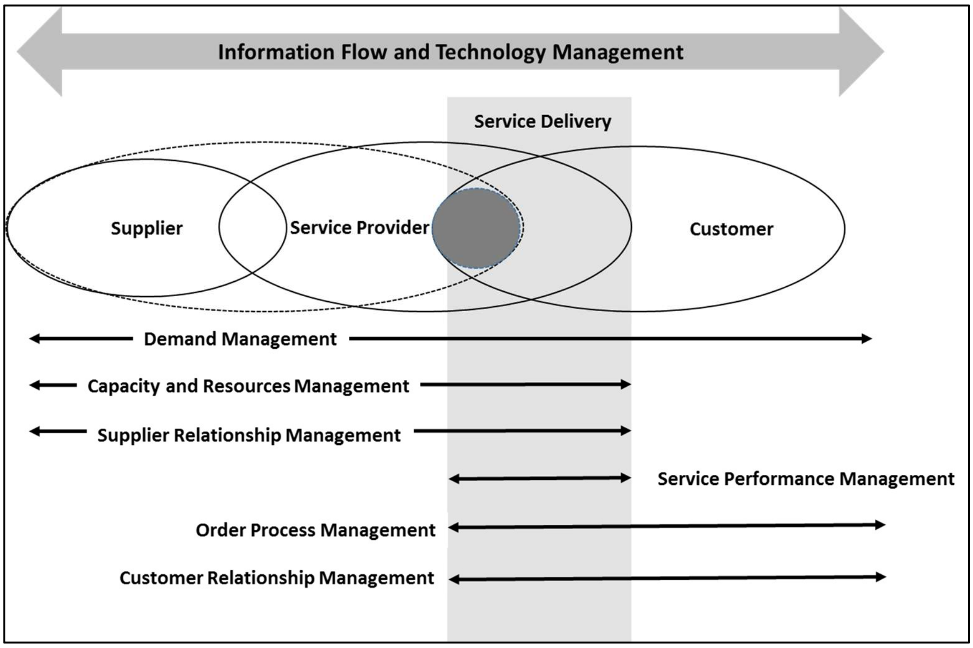

Figure 11: The IUW-SSC Model (Baltacioglu et al., 2007).

Demand Management: Demand is one of the greatest uncertainties in service industries as it is difficult to coordinate across the various service providers. Together with this is the complexity that services are not capable of being stored as inventory. Various strategies exist to overcome this, including the management of capacity, which is discussed further in section 2.5.

Capacity and resources management: Capacity management involves balancing the demand from the customer with the ability of the service provider, to deliver to the customer's demand. Various capacity management strategies exist that are discussed in section 2.5.

Customer relationship management (CRM) entails the processes of interfacing customers and the service provider or chain of service providers. This process creates customer demand that will lead to the placement of orders for service delivery. Customer relationship management is important in service industries due to many services requiring a high human interaction in the actual delivery of the service. This is for external customers and the management of internal customers (i.e. employees). The effective customer relationship management includes acquiring adequate information from these customers, appropriately classifying and monitoring them, and implementing appropriate customer management strategies in line with this.

Supplier Relationship Management: Based on the nature of services the various suppliers may interact directly with the customers more so than may be experienced in manufacturing. Relationship management of the suppliers is thus important to ensure consistent interactions with the customer.

Order Process management is defined as, all activities related to the obtaining of orders from customers, checking the status of orders as well as communicating on the progress of orders to customers and finally executing on the orders to meet customers' demand. This has a large impact on the customer's perception of customer satisfaction and service delivery. Information Technology plays an ever-increasing role in order process management as more services are delivered electronically without the intervention of an operator or other human interaction.

Service performance management is a key function in the service supply chain. The management of service performance is often a very controversial topic, as it relates to services with the view that it is easier to manage the delivery to a quantified specification. Moreover, quality delivery tends to be more subjective when it comes to services. It is the author's view that this is true for a certain set of services, but for a subset of highly standardised services it becomes easier to quantify successful service delivery.

Information and Technology Management: The supply chain requires the management and flow of information across the supply chain. The management of this information flow is thus important for the overall functioning of the service supply chain.

This section explains the Service Supply Chain model when taking a Service Provider viewpoint. It is based on popular models from the traditional manufacturing supply chains. The model as it stands provides a framework within which to contextualise practices related to service supply chains. Although, it is not intended for modelling a supply chain end-to-end. The elements provided within this model are important to consider when developing and evaluating Service Supply Chain models and should be contained in developed models.

2.3.6 Supplier-Customer Duality Perspective

Sampson (2000) considers the concept of a customer-supplier duality and bi-directional supply chains when describing service supply chains. Sampson (2000) believes that viewing supply chains in the classic sense of a one-directional chain of events lead to a narrow perspective of the complexity associated when modelling services in a supply chain. An interesting perspective of SSCM research is possible by considering the supply chain from the perspective of the customer (Maull et al., 2012). This section will elaborate this view of a customer-supplier duality when considering the service supply chain.

The nature of a manufacturing supply chain is receiving inputs from suppliers, processing or transforming those inputs and then delivering the outputs of the process to become the next set of inputs. Either these go to a customer or the next manufacturer makes the manufacturing supply chain easy to conceptualise. With service supply chains, the customer plays an active role as an input to the process. Customers may provide themselves in the forms of their bodies or minds, they may provide their possessions or they may provide information as inputs to the process (Sampson, 2000).

Sampson (2000) classifies services belonging to one or more of four categories:

1) Services that act on people's minds (e.g. education, entertainment, psychology);
2) Services that act on people's bodies (e.g. transportation, lodging, funeral services);

3) Services that act on people's belongings (e.g. landscaping, dry cleaning, repair);
4) Services that act on people's information (e.g. insurance, investments, legal services).

Based on this approach, all services act in reaction to inputs from the customer. The customer is thus the primary supplier to all inputs. This then leads to the concept of the customer-supplier duality.

Defining a service and the nature of the service may not be useful in the context of service supply chain management, as the definition focuses on the actual service and not the elements lying outside of the service. To be useful in the context of service supply chain management a definition needs to include the inputs and outputs of the service (Sampson, 2000).

Sampson (2000) excludes feedback from the list of customer inputs; as feedback is considered after an amount of processing has started. Customer sentiment is also excluded as it is regarded as general and not specific to the individual case.

In studying these service supply chains, the nature of bi-directionality is brought in. In most cases of the service supply chain, the customer provides an input but also eventually becomes the recipient of the service or outcome. Maull et al. (2012) summarise three types of bidirectional supply chains identified by Sampson (2007):

1) Single-level bidirectional: this is where the customers supplies inputs, receives the output. For example, a visit to the dentist. These supply chains tend to be very short. This is shown in Table 3.
2) Two-level bidirectional: This is where one aspect of the supply chain is outsourced to a third party; for example, the dentist might outsource the production of bridges and crowns to a specialist. Sampson (2007) stated that these supply chains rarely go beyond two levels. Shown in Table 4.
3) Customer-supplier duality that is not bidirectional: for example, DHL will pick up a parcel and deliver it to a customer that is not necessarily the same customer who supplied the parcel (Maull et al., 2012).

Sampson (2000) goes further to comment on manufacturing, that if a supplier also starts to become a customer then manufacturer starts to look more like a service provider.

Table 3: Examples of single-level bidirectional supply chains (Sampson, 2000)

customer- supplier	supplied input	service provider	supplied output	customer
companies or individuals	financial transaction records	tax accountant	tax statements	the companies or individuals
passengers	selves and baggage	airlines	transported passengers and baggage	the passengers
home builders	design preferences	architects	blueprints	the home builders
car owners	broken cars	auto repair shops	fixed cards	the car owners
individuals	money	banks	money and interest	the individuals
companies	business problems	consulting firms	analysis and reports	the companies
individuals	blueprints and preferences	customer home builders	a customer home	the individuals
patients	teeth	dentists	drilled teeth	the patients
students	minds	educational institutions	enlightened minds	the students
spectators	attention	sports teams	excitement	the spectators
constituents	community issues	governments	community action	the constituents
clients	legal problems	law firms	legal answers	the defendents
homeowners	buring house	fire departments	drenched house	the homeowners
land owners	property to sell	real estate agents	sold property	the land owners
patrons	empty stomach	restaurants	full stomach	the patrons
customers	questions about products	retailers	answers	the customers

Table 4: Examples of two-level bidirectional supply chains (Sampson, 2000)

customer- supplier	input output	initial service provider	input output	individual service provider's supplier
customer	photo subjects developed pictures in frames	photographer	exposed film developed pictures	film developer
patient	blood diagnosis	doctor's office	blood and test requests test results	laboratory
customer	demand garment clean repaired garment	dry cleaner	damaged garment repaired garment	seamstress
customer	risk assurance	insurance company	risk assurance	reinsurance company

Sampson (2000) lists three major implications of the bi-directional nature of the service-supply chain:

1) Major portions of production cannot begin until customers have supplied their inputs.
2) Because the inputs of the service are dependent on the customer and may differ significantly, the service outputs tend to be heterogeneous which results in a non-standardised production.
3) The location of the service execution tends to be customer-based instead of supplier-based.

Sampson (2000) lists practical implications of the bidirectional supply chain:

1) Bidirectional supply chains are generally short.
2) Service providers usually do not pay for inputs coming from customer-suppliers.
3) Bidirectional supply chains are inherently executed, as the inputs and outputs arrive with no ability to create stock. Furthermore, the nature of customer behaviour is such that the customer expects immediate service. Sampson (2000) describes this as Service Supply Chains being inherently JIT. Coping mechanisms are available to manage such demand but will be discussed in a later paragraph. Maull et al. (2012) summarise the various types of variability and how it differs, based on the Customer – or Provider Perspective, which is shown in Table 5.
4) The fact that the customer provides the inputs to the process results in a higher level of expectation and value to be added in the service from the customer. With manufacturing, the customer receives the product with little regard for the value that was added in the manufacturing process. This can simplify the process across the supply chain as the customer can easily establish if value was added during the supply chain. It can also complicate the process when customers provide sub-standard inputs with unrealistic value-adding expectations for the service provider

Table 5: Variability in Service Provider and Customer Service Supply Chains (Maull et al., 2012)

Types of Variability	Provider perspective	Customer perspective
Request variability	Different requirements from each customer	Different requirements from each service provider
Arrival variability	Peaks and troughs in service demand	Different availabilities and need to consiuder delivery times
Capability variability	Customers have different skill levels	Service Providers have different skill levels
Effort variability	Some services require customer input/participation and customers will have differing willingness to make effort	Some services require provider input/participation and providers will have differing willingness to make effort
Subject preference variability	Different and contradictory views of what constitutes good service	Different and contradictory views of what constitutes a good "customer" (that is, service provider)

Sampson and Spring (2012) identified the roles that the customer may play in the service provisioning process:

1) The customer as a design engineer, where customers express views on how the service should be designed and delivered.
2) The customer as production/operations manager, where the customer directs the service provider as to how the service process should be conducted.
3) Customers as inventory, where customers are waiting in line or waiting for their belongings or information.

Sampson (2000) describes two blueprints that may be useful in this approach, the one being a time-based interaction and steps, and the other a customer visit and re-visit based view on the interaction.

2.3.7 Evaluation of Service Supply Chain Models and Perspectives

The previous paragraphs described various Service Supply Chain models and perspectives. The different perspectives highlight different aspects of the supply chains that introduce useful dimensions, but also result in consequences that may not be suitable in modelling a service supply chain depending on the required outcome.

A critical evaluation of the approach proposed by Sampson (2000) of the Customer-Supplier Duality, which is viewing the supply chain from the customer specific perspective and with bi-directional nature in mind, leads to different insights that are valid. It is the author's view that the approach is applicable when considering services and manufacturing in general. In considering the three major manufacturing process steps in SCOR (which is described in Chapter 3), the Make process can be regarded as Make to Stock, Make to Order or Engineer to Order. In this context, Make to Stock fits Sampson's (2000) perspective on manufacturing perfectly. If one considers the definitions of Make to Order, where the product is only made based on a specific customer order and may include configuration of the specific order. Or Engineer to Order, where the product is designed to a specific customer's requirement, this tends to have a large amount of customer interaction. From this, many manufacturing processes can be identified as having the customer as supplier and being bidirectional in nature.

The view of services having customer-supplier duality and manufacturing not, is thus only true if one considers the services and manufacturing in their general sense. If one looks at a classification of the manufacturing, there are manufacturing processes that tend to be more toward characteristics commonly associated to services. Similarly, if one considers all services generally the characteristics of Sampson (2000) are easily attributed to services. Although there are few (if any) services that do not conform to the principles described by Sampson (2000), the more the services are standardised the less the dependent on the customer inputs, and the more the service will tend toward the nature of a Make to Order process. The principles and views on manufacturing and services come from the generalisations that manufacturing is highly standardised (more Make to order) and services are highly customised (analogous to Engineer to order). This may simply be because manufacturing has gone through a level of industrialisation, which we have only observed recently with greater frequency in services. This bespoke nature traditionally attributed to services may thus decrease as the level of industrialisation increases (as has been discussed in section 2.2).

Maull et al. (2012) argue that when taking a service provider perspective, the influence of the customer is acknowledged and the approach addresses the customer. Although, the provider view considers the customer as relatively passive where the customers provides inputs, which are acted upon by the provider. While this is used to argue toward a customer centric view, it is the author's view that it conversely implies that with the standardisation of services and their inputs, a provider perspective can be used to accommodate a customer influence with a limited set of inputs.

When considering the system from a customer perspective, the interaction will most likely be limited to one tier of interaction, which revolves around the customer (Maull et al., 2012). This will limit the use of a process, as the process will simply show interactions between the customer and the next input block - allowing little opportunity for supply chain optimisation. This is further support for taking a service provider perspective in this study, with the objective of optimising an end-to-end supply chain.

In the Service Provider perspective, the critical nature of the customer may be underestimated. Customer inputs are considered but they are considered in a very static nature or with limited options available. This may be acceptable when modelling supply chains that tend to be standardised but become less appropriate when modelling supply chains that are very bespoke. The approach of the Service Provider may thus be suited if the services considered are the standardised back-office services.

Service Dominant Logic and Goods Dominant Logic allows perspectives to market and differentiate entire supply chains. This is an attempt to seek the value-adding activities of the service or the product, rather than simply extracting value based on the physical good. It serves to formulate strategies to improve the overall value to the customer but is not intended to optimise the operational supply chain for greater efficiency.

This study will consider the attributes that have been described by Sampson (2000) but will continue to model the supply chain in a time-based nature, with inputs and outputs from suppliers and customers in a linear chain from end-to-end. The bi-directional nature of the supply chain needs to be considered in developing an enhanced SCOR model for services options or variation. This will be discussed in section 4.2.6.

2.4 Proxies to Inventory

One of the major differences between modelling a product or a service is the tangible nature of a product as opposed to a service. When one asks the question: "What flows?" The question is not always easily answered within the SSC. Here, authors explore proxies to inventory, where different concepts are modelled as a "replacement" for the concept of inventory. Thus, enabling the modelling of the SSC in a process-driven approach, this is essential in using a model like the SCOR model.

Ellram et al. (2004) explain that the outcomes or economic activity generated varies greatly when considering the outputs of services. As examples: for miscellaneous repairs, the output is physical;

for education, the output is intellectual; for churches, the output is spiritual; and for motion pictures, the output is experiential.

Giannakis (2011) explains this problem through the perishable nature of services that makes the adoption of the SCOR model difficult. The upstream amplification of service activity, as a result of the bullwhip effect, is analogous to the amplification of upstream inventories in manufacturing companies. Consequently, the changes in demand from upstream processes have an unpredictable impact on the capacity of the process. Thus, in the case of Giannakis (2011), capacity is seen as the proxy to inventory. This view of service capacity, being used as a proxy for inventory, is also taken by Lee et al. (1999) who believe that inventory strategies should be applied to service-capacity planning in an environment of uncertain future demand. In this case, capacity has a dual role in the supply chain - it is modelled in the traditional capacity perspective but is also viewed from the perspective as the inventory. The outcome from Giannakis (2011) is that the developed model conceptualises the capacity of service firms as a resource inventory, to build a service offering. In reviewing the H-P supply chain model, Ellram et al. (2004) find that the inability to inventory services requires the focus on capacity levels and flexibility, versus the approach of creating inventory as a means to balance supply and demand.

Giannakis (2011) also considers Intellectual Property (IP) as the proxy to inventory, with intellectual property having the characteristic that it can be used indefinitely. This is then a special type of inventory that can never be depleted. The main question to ask in these instances is, "What is objective is of the modelling and how is it being modelled?" In this case, it should be noted that the service supply chain being modelled was professional services.

Furthermore, the proxies to inventory have been the customers themselves. In using service-dominant logic, where the customer plays an active role in the SCM, Maull et al. (2012) consider scenarios for customers as inventory, where customers are waiting in line or waiting for their belongings or information. As an example, consider passengers traveling on an airline. In identifying queues and flow, the passenger (or customer) can be modelled to improve the overall SSC. A shortage of service capacity is the primary reason that customers are kept waiting in a service. as customer inputs arrive before the server is ready to handle those inputs. This is similar to the reason for inventories to be carried in the manufacturing context, as in the case of goods arriving before the system is ready to process them. In this case, the customers are in fact inventory and the techniques one would apply to inventory in the manufacturing context are then applicable to the service supply chain (Sampson and Spring, 2012).

There are various ways in which the customer waiting is similar to inventory in manufacturing:

1) Both incur holding costs, although the former is usually measured in minutes and the latter measured in months,
2) Both require a storage location, although customer inventory may require more comfortable facilities than physical goods inventories, and
3) Both are an outcome of inadequate capacity planning, scheduling, and coordination.

A difference between the treatment of inventory in the manufacturing and the customer as inventory in services, is deciding how to deal with excessive waiting, which includes psychological dimensions (Sampson and Spring, 2012).

In studying Schmenners process matrix (which was discussed in section 2.2.1), Sampson et al. (2012) observe that in the quadrant of service factory, the customer plays two roles: that of inventory and that of product. The management of service factories thus require a focus on the efficient movement of customers through the production system. Furthermore, the customer as inventory was applicable to all four quadrants of Schmenner's process matrix. This emphasises the importance of managing customer-waiting time in the study of service supply chain management.

A further popular proxy to inventory is to study value as through the very popular value-chain analysis. In the service supply chain, service value is created for customers by means of planning, organizing, implementing, and controlling the capacity flow, information flow, value flow and service process flow of SSC (He et al., 2010). In teaching, knowledge is considered the item that flows. Thus, many items could be considered to flow and act as proxies to products or inventory in the SSC.

This section focused on the various forms of substitutes or equivalents to inventory in the manufacturing context. There are many different forms of these proxies to inventory. It is important to note from this that various proxies to inventory may be chosen, depending on the type of service being observed and the goals or objectives of modelling the supply chain. It is further important to understand that the choice of proxy to inventory will change the modelled supply chain, based on the perspective of what is modelled. It is important to find the proxy to inventory, as the fundamental part of modelling a supply chain is the tracking of a product as it progresses through the supply chain. If the supply chain is to be modelled from a service provider perspective and similarly to a manufacturing supply chain, a proxy to inventory must be identified.

Capacity is a recurring topic, which the majority of the literature related to service supply chain management. A reference is constantly made to capacity. In some cases, the concept of capacity is seen as analogous to inventory - as was shown in the previous paragraph. This is one dimension of the use of capacity within the supply chain and will be discussed further in the next section when discussing proxies to inventory.

2.5 Services and Capacity Management

A further dimension of the role of capacity in service supply chains is considering capacity as a managing objective. At the core of many of the service supply chains is the optimal use of capacity in the overall chain of delivering service. This is shown in the model of Armistead et al. (1994), where the focus is on strategies toward the management of the service capacity, depending on the type of service that is being considered. The model of Armistead et al. (1994) was discussed in section 2.2.1. This section will rather not focus on the model, but rather the implications of the model on the management of capacity. This is useful to consider as it starts to deal with the consequences in selecting a specific approach to supply chain management, which will have to be considered in developing a model for service supply chain management.

The management of capacity in the service supply chain becomes very important as a strategy to manage the balance between customer demand and supplier capacity. A key concept here is the concept of inventory, or the lack thereof in services. In the case of services, the use of inventory is not available based on the nature of services. The result is that the management of capacity in services becomes even more critical and the use of inventory is not an available coping strategy.

The nature of service delivery and the direct involvement in the service delivery process, complicates capacity management. It restricts the options open for controlling the process of matching supply with demand across the whole service delivery system. The four general options for operational control are altering capacity, holding inventory in anticipation of demand, requiring customers to wait for the service, or influencing demand in other ways (Armistead and Clark, 1994). This first requires fan understanding of the demand and the demand pattern, and secondly looking at options for coping with fluctuations in capacity. Relating this to service supply chain management would mean that the goal of a service supply chain is to ensure that we have as few scenarios as possible where we are not able to serve the customer - balanced with having as little idle capacity as possible.

Two strategies are proposed for managing capacity in services, these being the level strategy and the chase strategy (Sasser, 1976). To expand on these two strategies, the elements influencing the output of service delivery must first be considered. Armistead et al. (1994) describe three factors that influence the output of the service delivery process;

1) The service load represented by the variety of the services being delivered, the resource absorption per service, the variation in the demand patters and the way in which demand is managed for example by price changes or appointments.
2) The way the capacity task is managed using techniques of forecasting, prioritizing, scheduling, managing bottlenecks, and altering capacity. In services this is expanded to also include coping mechanisms, which becomes applicable for services.
3) The extent of capacity leakage, which is where the capacity available could not be utilised. Examples of this type of loss are key resources are not available, quality failures, scheduling losses, and loss at changeovers associated with achieving flexibility.

These factors are illustrated in Figure 12, which then have the resource capacity and the service output is factors influencing these elements.

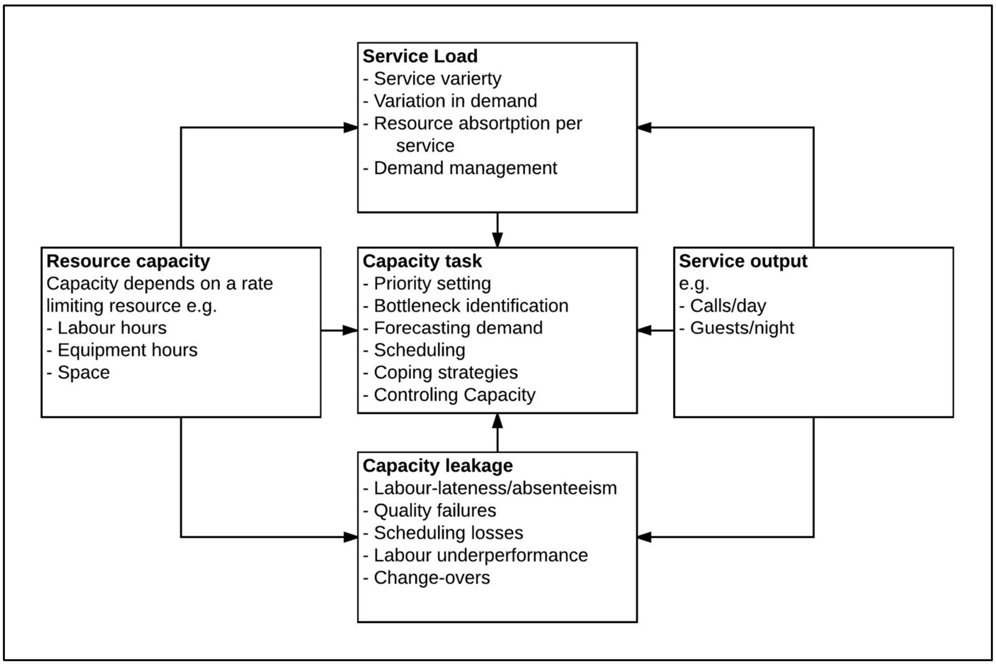

Figure 12: Capacity Management (Armistead and Clark, 1994)

Either when demand is easier to manage, because it is more predictable or because customers can be told to wait, level strategies are more applicable to managing the balance of demand and capacity. Chase strategies are used when the customer has an immediate need and the customer will not wait for capacity to become available. They are used to at least to get the process started and taken to a reasonable stage so that customers feel satisfied (Armistead and Clark, 1994).

Coping strategies become relevant for service companies as there will inevitably be a time when the available capacity to satisfy demand in the required timeframe expected by customers will run out. This is the area that most service managers would recognize as coping. In these circumstances there are two possible courses of action:

1) To allow service quality standards to fall in an uncontrolled way.
2) To try to control the fall in service standards, thereby protecting the service standards for the core service.

These may be simplified to be bad copers and good copers (Armistead and Clark, 1992). Service organisations that fall into the category of good copers follow capacity management practices that focus on the service quality together with resource productivity. These practices include:

1) Improving their forecasting capabilities,
2) Setting clear quality targets,
3) Setting clear resource productivity targets,
4) Understanding the bottle-necks in service delivery and manage them,
5) Understanding the need for flexibility and build it into the service delivery,

6) Understanding the critical failure points in service delivery, and
7) Understanding the critical and sensitive hygiene dimensions of service quality

Armistead et al. (1994) refine these coping strategies by giving coping strategies that are applicable to the different quadrants of the Operational Focus for Service Delivery model, which were discussed in section 2.2.1. These strategies for each quadrant are:

1) Client-driven interaction [C-F] –B: The main capacity strategy is more likely to be level because of the professional status of front office staff. The assumption being that the service is highly valued by the customer. The approaches to coping include:
    a. Establish customer expectations;
    b. Starting the first stage of the process;
    c. Keeping in touch with clients;
    d. Having associates/locums who can help out;
    e. Using back room staff to provide customer care, though the organization must be careful that this is not perceived as mollifying clients;
    f. Downgrade the service offering in a planned manner.
2) Front to back driven, C- [F-B]: The main capacity strategy is towards level because of constraints on staff with the necessary skills, or because specialized equipment is required. The approaches to coping include:
    a. Managing customer expectation in the front office;
    b. Front office knowing the status in the back room to be able to update and renegotiate with customers;
    c. Confuse ignorant customers with the back-room complexity.
3) Operations driven, C-F- [B]: the main capacity strategy could be either chase or level. The approaches to coping include:
    a. Downgrade the service protecting sensitive hygiene dimensions of customer service;
    b. Rely on front office relationships with customer to minimize damage in periods of coping;
    c. Prioritize work.
4) Customer participation driven, [C-F-B]: the main capacity strategy is more towards chase. The approaches to coping include:
    a. Focusing on customers in trouble;
    b. Action/escalation teams;
    c. Provide a basic no-frills service.

This section elaborated on the strategies linked to the management of capacity. This highlights the differences to capacity management between services and manufacturing. Given the lack of the concept of inventory and how strategies in services need to be changed to accommodate this difference. This study focuses on the services that can be categorised under the Operations driven quadrant, but the other quadrants should be considered, as the principles of manufacturing may be applicable to some of these other quadrants and not exclusively to the Operations driven quadrant.

2.6 Summary

This chapter focused on the concept of the service supply chain and tried to introduce the various models in industry of service supply chains, which differ, based on the perspective taken. Further, the chapter highlighted that services cannot be considered as a singular concept and that they are in fact heterogeneous. To account for these diverse services, descriptions of services together with models of services were provided.

The chapter identified the type of service that would be most similar to manufacturing constructs - services that were defined in the Operations driven quadrant of Armistead et al.'s (1994) Operational Focus for Service Delivery model. The services in the Operations quadrant are described as services that are standardised and executed from the back room. In this study the concept of back office will be used rather than back room, as concept of back office is often used within the services industry. The services being considered will thus be referred to as the standardised back-office services during the rest of this study.

The chapter further considered the service provider perspective for modelling the service supply chain, as the most appropriate for the purpose of managing the flow in the chain across various suppliers to the eventual customer. Alternate views mostly focus on modelling the interaction between the service organisations and the customer, capturing the interactions and the value the customer receives. These views are not unique to services but may apply to certain manufacturing processes, just as the concepts may not apply to some types of services as to others. This study will approach the customer interaction as valid to all services, but will have less of an impact across the entire chain when considering standardised back-office services, as opposed to services that are not standardised.

Finally, the chapter highlighted two areas in the study of services in the service supply chain that require different views when considering them from the perspective of services. These are the concepts of proxy to inventory and the management of capacity.

The subsequent chapter will build on these concepts and discuss the SCOR model. Specifically, how SCOR models are adapted to industries and adapted for services specifically.

Chapter 3
Literature Review: SCOR Model

The previous chapter considered the concepts of services, supply chain management and the bridge between services and supply chain management. It was shown that supply chain management had grown out of manufacturing and that manufacturing had evolved over time. Further, it was shown that services have gone, or are undergoing a similar evolution. Based on this, services cannot be considered as a singular concept, but rather a collection of various types of services. These different services are changing as the concepts of services evolve.

The concept of supply chain management in services is studied within this environment. There are various approaches to supply chain management in services. A provider-centric approach is taken, allowing for the modelling of processes across the chain - with the goal of optimising the end-to-end chain of suppliers and distributors.

This chapter will now consider the SCOR model. The SCOR model takes a process approach to modelling supply chains. The chapter will consider the most important models but follow the SCOR model due to its popularity and fit to the overall objectives of this study. A description of the SCOR model and approaches to the adaptation of the SCOR model for various applications will be included. Finally, a discussion on the adaptation of the SCOR model will be described in this study.

Supply Chain Reference Models are used to simplify or give guidance when modelling a supply chain. Modelling any process or chain is possible with the simplest of techniques, or with very mature and complex modelling methodologies. Supply chain reference models attempt to make it easier for users to model their supply chains and to cover the essential items relevant for the supply chain. Modelling of supply chains can be time consuming and mistakes are easily made. Supply Chain reference models are used to address the potential pitfalls in modelling supply chains. Reference models are conceptual models that have been developed to be reused during the modelling process. Reference models can be reused; by taking parts of original models and adapting and extending them (Stein, Heddier, Knackstead and Becker, 2014, p17).

SCOR is seen as the de facto reference model for supply chain management. It is generally accepted and shapes how companies approach and describe their supply chains (Hellingrath, B., and Deuter, P., 2014; Georgise et al., 2012; Huan et al., 2004; Giannakis, 2011; Rotaru, K., Wilkin, C., and Ceglowski, A., 2014; Sellitto, M., Pereira, G., Borchardt, M., Da Silva, R., and Viegas, C., 2015; Long, Q., 2014; Medini, K., and Bourey, J., 2012; Kocaoğlu, B., Gülsün, B., and Tanyaş, M., 2013; Thunberg, M., and Persson, F., 2014; Webb, G., Thomas, S., and Liao-Troth, S. 2014; Delipinar, and Kocaoglu., 2016). In a study of education programmes in supply chain management (Bernon, M., and Mena, C., 2013) it was found that the structure of the Supply Chain Council's SCOR framework had shaped the structure of approaches to supply chain management to the "Plan, Source, Make, Deliver and Return" process model.

It has been shown that SCOR is very popular in Supply Chain Management and that many studies have been done in adapting SCOR to various industries. Even though the use of the SCOR model has many benefits in modelling of the supply chain, it still has limitations. Its intended purpose to be applicable across a large number of industries also makes it generic. This in turn means that there is specific industry knowledge that is not captured within the SCOR model, which may have been relevant to the specific supply chain being modelled (Stein, Heddier, Knackstead and Becker, 2014:17).

SCOR is one of many models that may be used to model the supply chain. It is necessary to compare the SCOR model relative to other supply chain management models. Three popular models exist within the field of supply chain management, these being: the HP model, the SCOR model and the Global Supply Chain Forum (GCSF) model. Table 6 summarises the characteristics of the three models. All three models focus on the flow of goods between the various parties of the supply chain. All manufacturing supply chains have this flow of goods, from the source through the manufacturing and distribution parties, to reach the end customer. This may also include the return process. The SCOR model and GSCF model link the various parties through processes within the supply chain (Ellram et al., 2004). The focus of both the SCOR and GSCF is to describe the linkages between the various actors in the chain. This is one of the focus areas of this study in looking at process orientation and also the linkages between the various actors.

In evaluating the differences between the SCOR and the GSCF model, Lambert, García-Dastugue and Croxton (2005) evaluate the two models according to scope, intra-company connectedness, inter-company connectedness and drivers of value generation. From this evaluation, a major distinction made by Lambert et al (2005) is that where the GSCF model focus on the relationships within the supply chain, the SCOR model focuses on the transactional efficiencies. The SCOR model is more similar to the modelling of a workflow or the objectives set out in business process engineering. The objective of this study is to provide a tool to model the flow of the services across the chain making the SCOR model more applicable. The GSCF model provides a list of functions within the organization that are typically found in a supply chain and assists in ensuring the relationships between the functions within the organisation and between organisations is maintained.

Of all the models described, the model that is receiving the most attention and research is the SCOR model (Barnard, 2006). The SCOR model is chosen as the base model for developing a model for standardised back-office services in this study. This is based on:

1) The suitability of the SCOR model to the intended research through its process orientation and
2) The industry acceptance and research around the SCOR model.

Table 6: Comparison of HP, SCOR and GCSF Models (Ellram et al., 2004:9)

	Concept	Focus	Support for Services SC	Weakness for Services SC
H-P Model	• Suppliers, factories and customers are linked in the flow of goods, information and money, in an uncertain environment. • Multiple inventory stocking locations and possibly "excess" capacity provide the buffer for that uncertainty.	• Focus on depicting the physical flow of goods among members of the supply chain. • Focus on recognizing and managing uncertainty. • Uncertainty is represented by statistical variances.	• Considers buffers against uncertainty. • Utilize capacity levels and flexibility versus inventory. • Allows consideration of tradeoff in capacity level of the service provider and wait and service times for the customer.	• Services cannot be inventoried. • Cannot easily address the differences in quality of services.
SCOR Model	• Tool for charting supply processes and activities. • Utilizes a business process reference model that links process description and definition with metrics, best practice and technology. • Organized around five primary management processes of plan, source, make, deliver and return.	• Focus on processes that link the supply chain. • Focus on depicting the physical flow of goods among members of the supply chain.	• Services are process driven	• The separate processes of make, deliver and return do not fit services. • Services do not have a return cycle
GSCF Model	• Conceptualizes a supply chain that includes three elements: the business processes, the management components and the structure of the chain. • Product and processes flow through the chain, with consideration given to the return process flow as well	• Focus on processes that link the supply chain. • Focus on depicting the physical flow of goods among all members of the supply chain from supplier's supplier to final customer	• Participants from the beginning to end of the chain are included encompassing suppliers as well as customers. • Coordination of information and integration improve the overall flow of the chain. • Utilizes a process view to meet uncertain demand	• Services do not have a return cycle. • Fits the product and component flow of goods.

Huang et al. (2004) describe that research into supply chain management can be categorised as operational, design and strategic. The supply chain operations reference (SCOR) model is a strategic planning tool that allows senior managers to simplify the complexity of supply chain management. From this it can be deduced that one of the goals of the SCOR model is to simplify complex scenarios, making it easier for senior management to make decisions about their supply chain. Furthermore, the SCOR model is a diagnostic tool that assists managers to design and manage supply chain processes of an organisation at the strategic as well as operational level (Giannakis, 2011).

The SCOR model allows a process-orientated view in depicting the service supply chain steps. This study will depict service processes in a chain of events, showing the flow and handovers between various parties. Furthermore, it will model the quick translation to best practices and key KPIs that SCOR provides when modelling the supply chain. The SCOR model is further chosen as the aim of this study to provide an aid in modelling complex supply chains in the services industry, which is in line with the goals of the SCOR model. Lastly, it is seen as a model that assists managers in modelling their supply chain by providing guidance and best practices during the modelling process.

3.1 What is SCOR?

The previous section highlighted the popularity of the SCOR model and also identified dimensions where it is different from other reference models. This section will consider what the SCOR model is and what the objectives of the SCOR model are. This forms the basis for understanding the objectives of the SCOR model and further supports the selection to use it as the base model for adaptation to services. The need for the adaptation of the SCOR model is also briefly touched on. The SCOR model was designed by the Supply-Chain Council (SCC) and provides a standard methodology with comprehensive measures and techniques to improve supply chain operations. “It is widely acknowledged as the quasi-industry standard for supply chain management” (Georgise et al., 2012). A major objective of the SCOR model is to improve alignment between marketplace and strategic response of a supply chain, on the premise that the better the alignment, the better the bottom-line performance (Huan et al., 2004).

According to (Huan et al., 2004), the SCOR model integrates the well-known concepts of business process re-engineering, benchmarking and process measurement into a cross-functional framework, which contains:

1) Standard descriptions of management processes;
2) A framework of relationships among the standard processes;
3) Standard metrics to measure process performance;
4) Management practices that produce best in class performance; and
5) Standard alignment to software features and functionality.

The SCOR model is used to allow users to easily create and model supply chains, using a simple construct amongst companies. After modelling the supply chain, the reference model gives the users of the model access to best practices and metrics aimed at quickly analysing and improving the supply chain.

SCOR does not provide modelling tools to model each process in infinite detail. High-level building blocks are provided from sufficient detail to understand the interdependencies between companies and the flow of information and goods between them. The approach to supply chain management is not to model all the detail, but rather only the essential elements required to describe the supply chain. High-level processes like plan, source, make and deliver are measured through a small number of key KPIs to successfully manage and operate the supply chain (Sengupta, Heiser, and Cook, 2006).

The process categories in the SCOR model are divided into three levels. Level I is the top level that deals with process types. Level II is the configuration level and deals with process categories. Level III is process element level and is the lowest level in the scope of the SCOR model (Huan et al., 2004). Giannakis (2011) takes a different perspective on these levels, preferring to see them as the strategic, tactical and operational activities that take place to support the supply chain operations.

3.1.1 Application of SCOR to Services

In their research, Huan et al. (2004) identified areas in which they suggested the SCOR model be expanded. They proposed that the concept of change management be included and argued for changes in the SCOR performance metrics for decision-making. We thus see that authors are continually evaluating the SCOR model from various dimensions. This is either with the view of improving it, or adapting it to better suit a specific scenario or application. Thus, the SCOR model is seen as a starting point, where researchers apply the base model to the specific industry or application to make the reference model more relevant for its application.

SCOR finds its roots in the modelling of manufacturing supply chains. This may mean that SCOR is not always applicable to service supply chains. Baltacioglu et al. (2007) argue that an important feature of manufacturing-orientated supply chain models is that the relevant business and/or logistics activities are generally realised within a specific company or organisation. Services, however, have a characteristic of simultaneity - making it inapplicable to service supply chains. Therefore, an alternate model is required for the modelling of service supply chains. Simultaneity refers to the characteristic that many services required the various actors that form part of the service supply chain, to execute at the same time rather than in a sequence. This concept of simultaneity is derived from the viewpoint that all interfaces centre around the single point of the customer, making them an integral actor of the supply chain.

Baltacioglu et al. (2007) discuss general functions that are defined by the Global Supply Chain Forum as part of SCOR, with respect to manufacturing industries. These functions are classified as customer relationship management, supplier relationship management, customer service management, demand management, order fulfilment, manufacturing flow management (which includes sourcing, making and delivering), product development and commercialisation, and returns management. Due to the differences between manufacturing and services not all these functions are relevant to services.

With regards to SCOR as a means of modelling services, Giannakis (2011) writes the following: “As it stands the SCOR model falls short in studying services’ supply chains as the Make, Deliver and Return processes (in the way that they are defined) bear no relevance to business services”.

This study will evaluate the concepts of the SCOR model as it applies to a specific type of service that has characteristics closer to that of manufacturing. Services will not be considered as one general concept. The suitability and adaptation to this specific type of service will be examined.

3.2 Overview of SCOR model

This dissertation will not aim to describe the SCOR model in detail. Rather, only elements that need to be highlighted for the purposes of understanding the remainder of this section, as well as describing the areas that will be addressed in the revised SCOR model will be discussed.

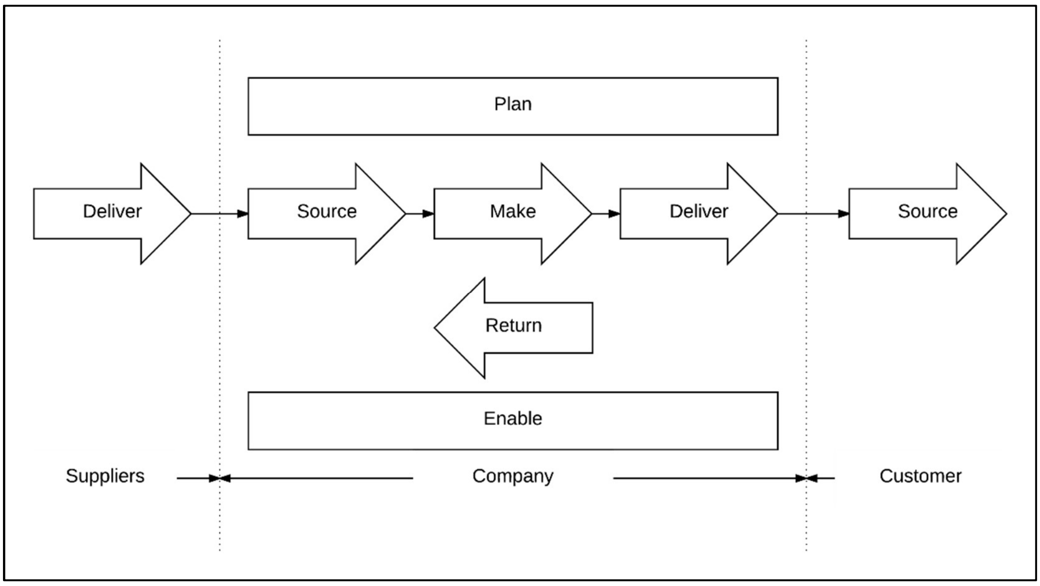

Figure 13: SCOR Model Process Elements (SCC, 2012)

The SCOR model divides all the elements into Plan, Source, Make, Deliver, Return and Enable.

These Level 1 processes provide an overall structure to the processes. These are then further classified into Level 2 Processes. As an example, the Make (sM) process has three Level 2 Processes; these being: Make-to-Stock (sm1), Make-to-Order (sM2) and Engineer-to-Order (sM3). These sub-processes are not various steps in the chains; but rather different types of processes that may be followed. Based on the type of sub-process chosen, Level 3 processes are defined. With the Level 3 processes we move away from the Level 1 and Level 2 approach of classification and towards process steps or process hierarchy to be followed. By way of example, in considering the Make-to-Stock (sM1) Level 2 Process, the Level 3 process hierarchy is Schedule Production Activities (sM1.1); Issue Material (sM1.2); Produce and Test (sM1.3); Package (sM1.4); Stage Product (sM1.5); Release Product to Deliver (sM1.6); and Waste Disposal (sM1.7). Each of the processes are linked to a description of the process, Best Practices, Performance Indicators, Skills, Inputs and Outputs. These artefacts are associated to the process at all levels and not only to the lowest level of process (i.e. Level 3).

This explains only one dimension of the SCOR model, namely the Business Process Re-Engineering dimension which results in processes. SCOR has a further 3 dimensions, that of Performance Benchmarking, Best Practice Analysis and Organizational Design. These items are included into each process block, as already described, but the SCOR model implementation requires wider implementation of these dimensions than the inclusion of the dimension on the process. The SCOR model also describes an approach and methodology of implementing the model, which then links to approaches and practices, especially as it relates to the benchmarking and implementation of performance indicators.

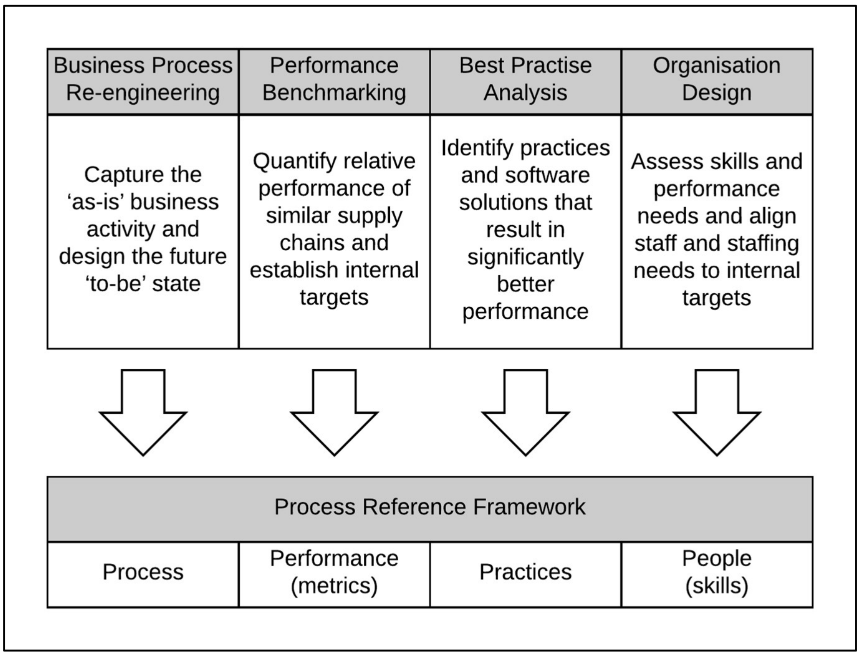

Figure 14: SCOR elements (SCC, 2012)

As an overview of the various process elements, the Plan process refers to the overall planning of the supply chain. Source, Make and Deliver are referred to as the Execution Processes in the supply chain. The Enable processes describe items that support the overall operation of the supply chain, although they are not directly in the process flow. Return processes were added later in the evolution of the SCOR model and identify the processes required when products or goods are to be returned via the Supply Chain.

This section has provided a brief overview of the SCOR model. It is not intended to describe the model fully as this can be obtained by studying the model. A derived model of the SCOR model used in manufacturing will have to address the levels of SCOR that are defined. It will further have to cover the dimensions covered by the framework. This section has provided sufficient background and context to support further understanding of this dissertation.

3.3 Use of SCOR for Services and Scope

Having chosen SCOR as the model to be used as the base on which to build a model suitable for industrialised services, it is useful to consider the scope to which the SCOR model will be studied.

In considering the levels of the SCOR model, the processes of levels one, two and three were defined to be generic and that processes from level four onwards to be situational specific. In studying the actual model, there are elements in level three that are very specific to manufacturing, with multiple references to material handling and inventory.

It is with this in mind that the scope from a process perspective is to review the SCOR processes up to and including the level three processes. The performance metrics associated to the processes are evaluated up to the level two process elements. This is done because the details within the level 3 process elements become too focused on manufacturing or are very context specific. This will be tested as part of the SCOR model adaptation discussed in Chapter 4, when analysing the performance metrics.

Best practices are not considered for the adaptation of the SCOR model. The best practices tend to be very specific towards the context and manufacturing specifically. The best practices are also not a requirement to demonstrate the use of the model to a potential user. This will be illustrated further in Chapter 6 when discussing the case study.

The scope of this study will thus be to provide an adapted SCOR model for services. Certain processes need to be considered, namely, the SCOR processes up to Level 3 with adaptation of the processes to suit services, and the associated performance metrics associated to all process up to Level 2 (including the Level 1 performance metrics).

The overall objective of adapting the SCOR model must be kept in mind. The objective is to establish whether the SCOR model is applicable to standardised back-office services without major modification. Further to the adaptation of the model, there is the objective of establishing whether the model created for standardised back-office services is useful in practice. The objective is to create a model that will be sufficient to establish its usefulness. The model will not to create all performance measures that are complete for services. Rather, the performance measures related to manufacturing will be translated for services, to act as a starting point for the users of the model to re-use or expand on the measures the users believe are relevant.

The objective is not to recreate an entire SCOR model for a specific type of service. The SCOR model itself has been created over several years and with the contributions from multiple members. The objective of this study is to use the SCOR model as the base to develop a model for standardised back-office services and to show that it is useful to have such a model for these services.

Best practices are not included in the adaptation of the SCOR model as the use of the model can be tested through the adaptation of the process elements together with the performance measures. Areas like Best Practice often refer to manufacturing specific systems or optimisation techniques. Best Practice is thus kept outside the scope of the model adaption.

3.4 Adaptation of SCOR

As discussed in previous paragraphs, the SCOR model is rooted in manufacturing and is often described as inappropriate in describing services. This is not only true for services but other industries as well. In a study of the use of the SCOR model in the mining industry Zuñiga, Wuest, and Thoben (2013) remark that the SCOR model is developed with manufacturing in mind and is not applicable to some of the mining processes. Here, the major difference is the way in which raw materials are obtained in the mining industry, namely extraction, which makes many of the material sourcing processes inappropriate to the mining industry.

Further, Georgise et al., (2012) refer to the SCOR model being adapted for research into developing countries. In a different study Burgess and Singh (2006) considered SCOR in the context of social and political factors and found that current approaches for analysing supply chains, which includes the Supply Chain Operations Reference (SCOR) model, are not comprehensive enough. This is even more so the case when it relates to understanding the complex social and political factors related to the supply chain. This highlights the constant work and evaluation of SCOR in different situations. And that it has become one of the industry standards in describing supply chain management and the basis to derive further models.

In a different study to enhance the SCOR model with Supply Chain Security (SCS) aspects, Böhle, Hellingrath, and Deuter (2014) remark that the original intention of SCOR was improved performance and efficiency of the supply chain operations. Based on this approach of efficiency, Böhle et al. (2014) looked to enhance the SCOR model by adding SCS dimensions to be used as a security management tool in the supply chain. They based their approach after studying the enhancement of the SCOR model, to include environmental dimensions of Supply Chain management (referred to as GreenSCOR) and provide a SCOR model capable of adding environmental practices to the end-to-end supply chain.

In a literature review, Georgise et al. (2012) classified papers and works related to the adaptation of the SCOR model into five categories:

1) To the manufacturing industry environment
2) To the service industry environment
3) To the military environment
4) To the geographical information system (GIS) and information technology (IT) environment
5) To the logistics operation's environment
6) To the collaborative supply network environment.

The following two sections will further consider the adaptation of the SCOR model for manufacturing and for the services industry.

3.4.1 SCOR Model Adaptation to Manufacturing Industry Environment

Even though the SCOR model is designed for and applied to manufacturing industries, various researchers have identified limitations and weaknesses when considering the application towards specific industries or when making the models more practically relevant. The adaptation of the SCOR model even has value for manufacturing (Georgise et al., 2012). Examples of these enhancements or adaptations, are the environmental impact or the risk management of the supply chain as discussed in the previous section (refer to section 3.4).

The adaptation of the SCOR model, for specific application or industries, is a practice that is commonly found in literature. It is now useful to consider the adaptation of the SCOR model to services specifically.

3.4.2 Adaptation of the SCOR Model for Services

In adapting the SCOR model for services specifically Stein, Heddier, Knackstead and Becker (2014) state that the immaterial nature of services, together with the key role that the customer plays within the actual delivery of the services, makes the application of the SCOR model as it stands inappropriate. Zuñiga et al. (2013) agree that current frameworks are built around manufacturing and do not address the service industries central complexity which is the customer. According to them, the SCOR model must be adapted in the service industry to model its processes. They believe that to correct the deficiencies the following must be understood:

1) What is the service?
2) Who is the customer?
3) How is the service delivered?
4) When is the service delivered?

This is in line with the approach taken by Sengupta et al., (2006) who provide a framework and steps to adapt the SCOR model for various applications. KPIs should be developed for each of the processes of the SCOR model (plan, source, make and deliver). These metrics should be grouped into primary and secondary metrics. By following this approach, Giannakis (2011) found the model to be unsuitable to services without significant structural changes. However, it must be emphasized that Giannakis (2011) focused on a specific type of service.

Giannakis (2011) chose professional services to be modelled. As already discussed, this is but one type of service and may well be one not very much suited to applying manufacturing practices. Giannakis (2011) concludes for each of the major processes of SCOR that:

1) Plan. The planning activities set the strategic direction of the SCM and communicate the operational and strategic intentions to the managers of the supply chain.
2) Source. The sourcing processes involve the activities conducted at the interface between the consultancy and its suppliers. The core resources that are sourced for management consulting involve human capital, intellectual property (IP), software applications, and information. The major difference with SCOR is the consideration of employees as core resources. SCOR strictly separates people management and recruitment, and identifies them as enabling and not core processes.
3) Make. The make processes involve the assembly of various resources to meet the client's requirements. This stems from the consideration that a consultancy's competence is its ability to draw on resources to provide a skilled client-engagement team.

4) Deliver. The deliver processes involve the actual client engagement.
5) Return. The inherent intangibility of consulting means that a "faulty" delivery of a service cannot be physically returned. If the original service is inappropriate, remedial processes such as analysis of client feedback and quality assurance occur, which are more analogous to the product-based SCOR return process

Based on the above, Giannakis (2011) concludes that the current SCOR performance measurement is not sufficient to measure service performance.

Georgise et al. (2012) refer to the two largest limitations of SCOR models for the service industry: semantics and process types. As an example of the adaptation of process types Giannakis (2012) added additional process elements. Consequently, the SCOR model integrity had changed to such an extent that the use of the SCOR model was irrelevant.

An example of the semantics is the definition and use of the "Make" process. Semantically, the "Make" definition in SCOR is the process where value is added to the product. Translating this "Make" concept to the service sector creates a situation where some of the intent and concepts, specific to manufacturing, may be lost in the translation to a new concept. There is no direct translation of "Make" in the service industries (Georgise et al., 2012).

3.5 Previous Approaches to SCOR Adaptation

After considering the various adaptations of the SCOR model to various applications and industries, specifically the services industry, it is useful to understand the various approaches taken to adapting the SCOR model and the rationale behind these approaches.

In a study into the various items that can be configured or changed within the SCOR model, Stein et al. (2014) define three approaches to adapting the SCOR model. These are:

1) Extending or Modifying Metrics and Performance Attributes: Add or modify performance metrics or best practices associated to the specific process. The actual process is kept intact with only modification to attributes associated to the process.
2) Extending or Modifying Process Elements: Adapt the process elements themselves.
3) Adding Specific Perspectives: Addition of new process elements.

In their study of the SCOR model for Supply Chain Security, Böhle et al. (2014) prefer an approach of extensions rather than modification. They state that the SCOR model is a robust and proven tool with all the development taking place in industry and the Supply Chain Counsel (SCC). Further, modification of the SCOR model was avoided unless absolutely necessary to accommodate the elements of Supply Chain Security (SCS). Rather, the preference was to simply enhance existing elements to accommodate the security dimensions of SCS. However, in practice this approach was not taken, as Böhle et al. (2014) felt that they could not always account for the intention of the SCC with a specific element. Consequently, this may compromise the model and result in the use of the model in an unintended way. A further consideration for not taking this approach (of enhancing the existing model) is that the revision of the model would go against the principle of maintaining the integrity of the current SCOR model. Subsequently, Böhle et al. (2014) took the approach of only adding additional elements and only enhancing existing elements, if the additional elements would create redundancy in the model.

Stein et al. (2014) found various items to configure in the SCOR model from their study. These are summarised in Table 7.

Table 7: Configurable Elements of SCOR Model (adapted from Stein et al, 2014:22)

SCOR Model Element	Description
Metric	Rates the performance of a certain process element
Performance Attribute	Benchmarks the performance of each process element
Process Type	Aggregates the subordinate process categories
Process Category	Process building block for configuring the supply chain
Elementary Process	Constitutional element on the third level
Elementary Process-Order (EP-Order)	Defines in which order the tasks have to be processed
Best Practice	Helps improving the performance of a certain process element

From the studies described above, it is important to highlight that the various studies enhanced the SCOR model in different ways. Generally, the adaptations to SCOR found in literature were:

1) To amend SCOR with further information that adds a certain dimension to the SCOR model, even though it is not to a specific industry. Examples of this approach are GreenSCOR adding environmental dimensions to the SCOR model, or Supply Chain Security adding security dimensions to the SCOR model, or adaptation of the SCOR model for developing countries (Georgise et al., 2012). Georgise et al. (2012) describe how the source process element can be enhanced to allow supply chain design dimensions. Huan et al. (2004) describe changes to the SCOR model to include Change Management in the Plan dimension, overall improved synchronisation between various parties in the supply chain and improve Key Performance Indicators (KPI's). Furthermore, Burgess et al. (2006) believe that models like the SCOR model further do not sufficiently consider complex social and political factors that are an integral part of any supply chain and required further expansion.
2) To apply the SCOR model to a very specific manufacturing industry requiring a narrowing of the existing generic model.
3) To apply the SCOR model to a totally new industry as is the case with services.

Each of these approaches require different principles and requirements to adapting the model, although the understanding of the various approaches is important.

3.5.1 Process to SCOR Adaptation

The previous paragraph described principles for adapting the SCOR model, as well as providing items that can be configured. This paragraph will consider the process and approach to adapting the SCOR model.

Stein et al. (2014) describe the following steps for model adaptation; first a literature study must be conducted for the specific industry or adaptation of the SCOR model, followed by the enhancement of the SCOR model with as much specific information as possible. Lastly, the user describes his special scenario by defining respective parameters based on the model that is built.

In their study of adapting the SCOR model to the mining industry, Zuñiga et al. (2013) describe the following steps:

1) Content analysis of the mining industry as well as the SCOR model.
2) The Level 2 and Level 3 processes of the SCOR model, with consideration of the specific mining process, then model the mining process. The SCOR Level 2 model provides a foundation for describing the processes and defining the terminology in an already accepted framework.
3) Where the SCOR model cannot be adapted for the process, other supply chain models must be studied to check if this can fit the required adaptation.

Giannakis (2011) followed the following sequential phases in adapting the SCOR model for services:

1) Conceptualisation of the supply chain processes that are involved in the creation and provision of consulting services.
2) Detailed conceptual mapping and migration of the supply chain processes of the consulting services to an adapted SCOR framework.
3) Identification of service performance metrics and adaptation of existing SCOR metrics in a service context.
4) Validation of the model with the help of the participant managers and through the development of a version of the model in a different service context.

In addition to the sequential phases, Giannakis (2011) proposed the following analytical steps to build the reference model:

1) The strategic planning processes (1-5 years) that shape the overall structure of the consultancy, as well as the operational planning processes of individual projects were analysed.
2) The processes for outsourcing (or in-sourcing) and procurement of IT solutions, including the supplier relationships that are formed were identified.
3) The process for creating the consulting service was identified.
4) The client engagement activities throughout an entire project were identified.
5) Interviews with senior consultants were conducted to validate the developed supply chain model. These interviews were also used to analyse the terminating processes of a client engagement including the quality assurance processes (Giannakis, 2011).

Common to the process steps of adapting the SCOR model is to have a thorough understanding of the industry or area that the SCOR model is to be adapted within. This section has given background to the steps taken in various studies in adapting the process dimension of the SCOR model. The following section will consider the performance measures in the SCOR model with the view of the adaptation of the measures.

3.5.2 SCOR and Performance Measures

A major component of the SCOR model is that of performance measures. Performance measures are used to describe the existing supply chain but are also used to design the objectives and improvements for the future. Measuring or monitoring supply chain performance reveals the gap between planning and execution, it also helps companies to identify potential problems and areas for improvement (Chae, 2009).

Sengupta et al. (2006) propose the development of KPIs for each of the SCOR model's meta-level processes namely Plan, Source, Make and Deliver. Additionally, they need to be hierarchically grouped such as primary and secondary metrics.

Sengupta et al. (2006) warn that the "more is better" view does not apply in supply chain performance measurement. The focus should be on "less is better". Companies should start with a small number of KPIs to manage and operate, and are necessary to monitor the meta-level processes (Plan, Source, Make and Deliver).

Chae (2009) suggests the performance measures to be broken into two layers namely, the primary and secondary layers. The primary metrics represent a company's overall supply chain performance. Secondary metrics describe the primary measures further, and are potential indicators of why the primary metrics are high or low while offering a detailed view of supply chain.

Similar or equivalent measures are to be found for the service supply chain. Cho, Lee and Hwang (2012) believe that the service industry can benefit from applying some best practices from manufacturing industry. However, the differences between service and manufacturing industries may require that specific service supply chain performance measures, reflecting service supply chain practices, be developed. There has been little research to date on service supply chain performance measurement, resulting in a need to further study measures that would be applicable to the service supply chain (Cho, Lee, and Hwang, 2012).

Hwang et al. (2012) six service performance dimensions, which are different from those for the manufacturing sector for services. These six dimensions are shown in Table 8.

Table 8: Six performance dimensions, issues and type of measure (Fitzgerald as cited by Cho et al., 2012)

Dimension	Issue	Type of Measure
Financial	Asset turn over Control of labor and capital costs Profit per serve	Profitability Liquidity Capital structure Market ratios
Competitiveness	Ability to win new customers Customer loyalty	Relative market share and position Sales growth Measures of the customer base
Quality of Service	Relationship between customer and organization Setting clear customer expectations Measurement of customer satisfaction	Overall service indicators: Reliability Responsiveness Aesthetics/appearance Cleanliness/tidiness Comfort Friendliness Communication Courtesy Competence Access Availability Security
Flexibility	Building volume, delivery spoeed and specification flexibility into service design in the long term Use of level capacity strategies Employment of part-tinme and floating staff Use of price and promotion strategies to smooth demand	Specification flexibility Volume flexibility Delivery speed flexibility
Resource Utilization	Utilization of facilities, equipment and staff	Productivity Efficiency
Innovation	Measurement of the success of the innovation process and the innovation itself	Performance of the innovation process Performance of individual innovations

However, Giannakis (2011) found that Cho et al.'s (2012) service performance dimensions with the existing SCOR metrics, do not measure the supply chain sufficiently.

In critically evaluating the measures given in Table 8, the measures provided tend towards qualitative than quantitative. This supports the view that services are more ambiguous due to their intangible nature, as has been discussed in Chapter 2. Using measures that tend to be more quantitative for standardised back-office processes, will support the view that there is a sub-set of processes to which the SCOR model is applicable without major modifications.

This section has considered a structure to performance measures in a primary and secondary hierarchy. Measures in this hierarchy for the manufacturing supply chain were provided; this was followed by suggested measures for a service supply chain. Suggested measures are provided with researcher's comments

The following section will use the foregoing paragraphs as the basis for laying out the approach to adapting the SCOR model for highly standardised back office processes.

3.6 Principles to be applied in Creating Adapted SCOR model

This section has focused on describing the SCOR model and then describing how the SCOR model has been adapted and the various ways in which it has been adapted for specific applications. By studying the various approaches to adaptation, a number of common principles can be derived.

This section will elaborate on these principles with the applicable reference to literature supporting the principle. These principles will be used as the guidelines for adapting the SCOR model in this study for services that are standardised and delivered from the back office.

The following principles will be considered in adapting the SCOR model for standardised services that are delivered from the back office. These five principles were the principles found to be common within the research and relevant to be named explicitly in the adaptation of the SCOR model.

3.6.1 Keep to the Original Model

As was discussed previously, there is a problem in moving between the supply chain models for manufacturing and services. The language used may not be applicable and in many cases, there is no direct translation for the concepts. Concepts like Make, Deliver and Return are not particularly relevant in services (Giannakis, 2011). Furthermore, in such a translation, some of the meaning or intent of the model may be changed.

A base premise of this study is that there are services where the SCOR model, as it applies to manufacturing, may be very applicable without major adaptation. Furthermore, the literature shows that changing the structure of the SCOR model is generally avoided when adapting the model, as changing the structure may change the overall intentions of the various elements and cause unintended gaps or overlaps. The first adaptation principle to the SCOR model adaptation is not to change anything in the model and use the model in an unmodified form as far as possible.

3.6.2 Semantics

The second principle to SCOR model adaptation will be to adapt the model only through the changing of words, using a direct translation or similar concepts. This is the least invasive approach when changing the model while being aware of the complexities introduced when changing semantics in the model.

3.6.3 Drop or Combine elements

In keeping to the principle of making as few changes as possible, remove or combine elements where it is not applicable or does not make sense to keep them. As a priority, the first changes should be made to Level 2 processes, keeping to the overall integrity of the SCOR model rooted in the Level 1 process. As a principle, a preference should thus be to keep the Level 1 processes intact.

According to literature commenting on the changes to Level 1 processes of the SCOR model, the return process is less relevant to service industries. It is also useful to note that the return process were only added later during the evolution of the SCOR model, as there was a need to model the return of goods in the supply chain. Georgise et al. (2012) state that the semantics and process descriptions become irrelevant because the physical return of a service is highly improbable. Once the service is delivered it is immediately consumed. Ellram et al., (2004) found that the make-deliver process is one process in services, as the service is created and consumed at the same time. They further maintain that there is nothing to return in the case of professional services.

Regarding the structure of service supply chains, Baltacioglu et al. (2007) believe that manufacturing supply chains imply linearity in the chain - making models like SCOR easy to apply. Services have the concept of simultaneity (described in section 3.1.1), which requires a different conceptualisation of the proposed service supply chain model.

Therefore, it can be argued that the model for the service supply chain should be kept as close to the original model as possible. Changes on Level 2 processes should be the considered before making changes on a Level 1. Furthermore, changes to Level 1 processes should be considered when the use of these processes would not make sense.

3.6.4 Find Equivalent KPIs

In considering KPIs, where the KPIs are not directly transferable, the equivalent KPIs need to be found or added to the model. As a general approach, the KPI will be removed if the KPI or Best Practice is not relevant to services and an equivalent is not available. New KPIs will be added if there are insufficient KPIs available from the existing model, or where there is a need for a specific KPI. KPIs will be based on the existing model and act as stimulus or a prompt for the user of the model to come up with their own KPIs, which may be more appropriate to their specific application.

3.6.5 Only add new KPIs if rooted in Literature and common place

In adding new KPIs, these best practices should only be added if found within literature, or when applying the supply chain principles to a specific service where the best practice is commonplace in that industry. This implies that the adapted SCOR model may not have many KPIs, as only those that could be transferred or found in literature will be included. Further additions to the model can be included, as it evolves or new knowledge is acquired.

3.7 Summary

This section has considered the SCOR model and within this description of the model, provided a scope for the study for a specific type of services. This section then went further to consider previous work on adapting the SCOR model - with two outcomes from this analysis.

First, the type of application of the SCOR model must be considered. Within this study, the adaptation of the SCOR model is an enhancement. Not in the context of adding additional constructs, but rather an enhancement through adaptation of the model to services and a specific class of services as a new industry.

Approaches to adapting the SCOR model provide steps and provide principles or guidelines within which the SCOR model is adapted. The principles that have been identified to be applied in this study were described in the previous paragraph and are summarised as:

1) Keep to the original model, if this is not suitable then try,
2) Use semantics to adapt the model, if this is not suitable then try,
3) Drop or Combine elements that are not applicable, from here
4) Find equivalent KPIs and Best Practices and if this is not suitable then try
5) Adding new Processes, KPIs and Best Practices if it is rooted in literature or from practical work in implementing the model.

These steps describe the detailed approach in adapting the model. This section also provided a high-level overview of how the adaptation of the SCOR model for an industry should be approached.

The previous chapter considered the characteristic of the service that is to be analysed in this study. The following chapter will take these characteristics and apply them to the SCOR model - to derive a newly adapted model based on the standardised services. This will be followed by the application of the model to a case study with two facilitated walk-throughs of services that fit the type of service being analysed. This will align to the general approach given for the adaptation of the SCOR model to new industries.

Chapter 4
SCOR Model Adaptation

The previous two chapters provided background into services and the nature of services, followed by a chapter discussing the SCOR model and the work related to the adaptation of the SCOR model.

This chapter builds on this work considering the current SCOR model. Moreover, it applies the conclusions from the study of services - together with the knowledge of the SCOR model - to review the current SCOR model. The aim is to provide a SCOR model that is suited to standardised back-office services.

The approach to the SCOR model adaptation is illustrated in Figure 15. The chapter starts by considering the Level 1 performance metrics associated with the SCOR model. These metrics are evaluated based on the foregoing work, to create derived performance measures suited to standardised back-office services.

A section reviewing the process elements of the SCOR model on a conceptual level follows this. This in turn is followed by a section reviewing the SCOR model on a process element level, and considers the applicability of the SCOR model to the services being considered. This review of the process elements is done up to the descriptions of the Level 3 processes.

The adapted process elements are used as an input to the subsequent section that focuses on the performance metrics identified in the analysis of the process elements. The performance measures are considered up to Level 2.

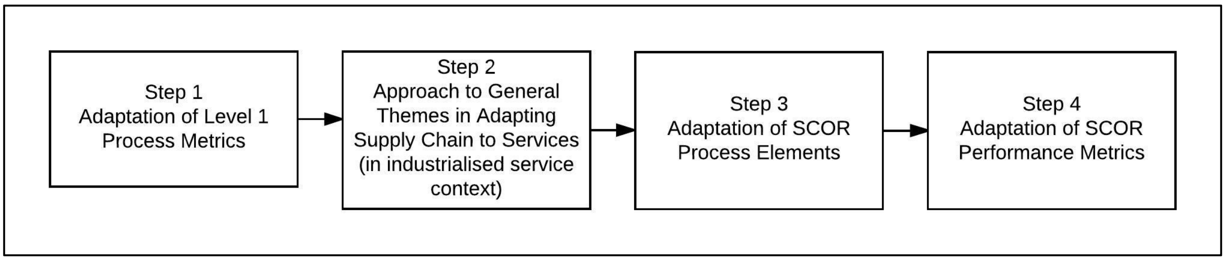

Figure 15: SCOR Adaptation Approach

The process of adaptation is then reviewed to assess the adaptations of the SCOR model relative to the initial objectives set out when reviewing the SCOR model.

The output of the review SCOR model is included in Appendix A.

4.1 Level 1 Performance Metrics

One of the starting points in considering the SCOR model is the Level 1 Performance areas. These performance dimensions are described in Table 9.

Table 9: Level 1 Performance Attributes

Performance Attribute	Definition
Reliability	The ability to perform tasks as expected. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the reliability attribute include: On-time, the right quantity, the right quality.
Responsiveness	The speed at which tasks are performed. The speed at which a supply chain provides products to the customer. Examples include cycle-time metrics.
Agility	The ability to respond to external influences, the ability to respond to marketplace changes to gain or maintain competitive advantage. SCOR Agility metrics include Flexibility and Adaptability
Costs	The cost of operating the supply chain processes. This includes labor costs, material costs, management and transportation costs. A typical cost metric is Cost of Goods Sold.
Asset Management Efficiency (Assets)	The ability to efficiently utilize assets. Asset management strategies in a supply chain include inventory reduction and in-sourcing vs. outsourcing. Metrics include: Inventory days of supply and capacity utilization.

In analysing these measures, they are as applicable to services as they are to products. In checking the language used, the areas where the word “product” or “good” is used, they can be replaced by the word “service”. For asset management, the concept of inventory is less valid given the perishable nature of services. In this case, it would be more appropriate to refer to “capacity”, in line with the discussion of proxies to inventory (as discussed in section 2.4). Capacity is already covered in this dimension, so in this case inventory is removed from the analysis.

It is interesting to note that inventory is not considered irrelevant. There may be service scenarios where the service requires the delivery of a device as part of fulfilling the service. In this case, the concept of inventory management is very relevant. In the case of services, the role of inventory is just not as pronounced as the SCOR model would make it.

The adapted level 1 attributes are shown in Table 10.

Table 10: Adapted Level 1 Performance Attributes

Performance Attribute	Definition
Reliability	The ability to perform tasks as expected. Reliability focuses on the predictability of the outcome of a process. Typical metrics for the reliability attribute include: On-time, the right quantity, the right quality.
Responsiveness	The speed at which tasks are performed. The speed at which a supply chain provides services to the customer. Examples include cycle-time metrics.
Agility	The ability to respond to external influences, the ability to respond to marketplace changes to gain or maintain competitive advantage. SCOR Agility metrics include Flexibility and Adaptability
Costs	The cost of operating the supply chain processes. This includes labor costs, material costs, management and transportation costs. A typical cost metric is Cost of Services Sold.
Asset Management Efficiency (Assets)	The ability to efficiently utilize assets. Asset management strategies in a supply chain include capacity reduction and in-sourcing vs. outsourcing. Metrics include: capacity utilization.

In analysing the Level 1 performance metrics linked to the performance attributes, the naming conventions linked to the metrics can remain intact without any further changes. The attributes are described in Table 11.

Table 11: Level 1 Performance Metrics

Performance Attribute	Level-1 Strategic Metric
Reliability	Perfect Order Fulfillment (RL.1.1)
Responsiveness	Order Fulfillment Cycle Time (RS.1.1)
Agility	Upside Supply Chain Flexibility (AG.1.1) Upside Supply Chain Adaptability (AG.1.2) Downside Supply Chain Adaptability (AG.1.3) Overall Value At Risk (AG.1.4)
Costs	Total Cost to Serve (CO.1.001)
Asset Management Efficiency (Assets)	Cash-to-Cash Cycle Time (AM.1.1) Return on Supply Chain Fixed Assets (AM.1.2) Return on Working Capital (AM.1.3)

This section has considered the high-level process performance metrics associated with the SCOR model and how this was adapted for services using changes in semantics. Further refinement will be required when describing the definitions of the measures in detail. The approach to transferring performance measures will be to adapt the Level 1 performance measures. All further performance measures adapted will be based on the performance measures that are associated to the relevant process elements.

The review of performance metrics is approached by reviewing all the process elements up to the description of the Level 3 measures.

This is covered in the following section. The section will first consider the processes from a conceptual level, followed by an analysis of the processes on a process element level. Following this, a set of performance metrics up to Level 2 will be compiled. These performance metrics will then be analysed on a granular level in a separate section.

4.2 Conceptual Review of Process Element

The previous chapters highlighted differences between manufacturing and services and provided insight into the nature of standardised back-office services. These individual items are recurring themes that arise when considering the differences between manufacturing and services and also when discussing the application of supply chain techniques to services. These recurring themes should be discussed in the context of the industrialised services. This discussion will be completed together with the discussions on the SCOR model, to derive changes to the Level 1 process elements. The outcome of this section will be an adapted SCOR model aligned to the requirements of standardised back-office services.

The major elements that need to be addressed before reviewing were identified in the previous chapters. These elements are: i) the Role of Return, ii) Combination of Make and Deliver, iii) the role of semantics, iv) role of inventory, v) simultaneity of services, and vi) the information flow.

These elements will be discussed in the following sections.

4.2.1 Role of RETURN

In Chapter 3, the role of Return was questioned by certain studies into service supply chains (Giannakis, 2011; Georgise et al, 2012; Ellram et al., 2004). The overarching rationale is that a service is considered consumed once it is delivered or produced. Ellram et al. (2004) does, however, clearly state if these examples are relevant to a specific type of service and more specifically the approach to be taken when it comes to standardised back-office services. Furthermore, the literature does not make the statement in absolute terms, rather that most services would not require such a process flow.

This statement would generally hold true for services where the Make process is that of adding value. If we were to consider highly standardised processes, there may be examples where the Return process is valid. Consider for example a repair process. If the repair process is completed via a chain of providers and one of the providers passes the service to the next provider, but did not complete the necessary steps, the logic of flow in a reverse direction may be valid. One could argue that time and value had already been added in the process, which cannot be returned. Yet, if one considers that the outcome is a repaired process one could conceive this to be a reverse process. Thus, there may be value in having a Return step in processes, especially in highly standardised back-office processes, where the proxy to inventory is not value added but rather some item of work that flows like a repair request or maintenance request.

It is useful to note that this does not mean that the Return process is applicable in all standardised back-office services. Although, it does mean that it may be relevant in certain types of services. The actual validity of the process in the model will depend on whether the implementers of the model use the construct naturally as part of their implementation, and not due to an academic or theoretical need. Applying this principle will adhere to the principle of changing the original model as little as possible, where it makes sense.

In analysing the detailed Return processes, there are certain processes that simply will not fit to services and its use will be limited. The Return processes are grouped under i) returning a defective product, ii) returning Maintenance, Repair, and Operations (MRO) product and iii) returning excess product.

The returning within the services context would typically be to return a service that was not sufficiently produced per the requirements in the previous step in the process. Thus, the concept of returning a defective product can find an analogous concept in services.

The returning of MRO products is the return of products used as parts of preventative maintenance. The concept does not find an easy translation within services. Even though services can be applied to preventative actions, these services cannot be kept within inventory so it is not possible to return inventoried services back in the supply chain. Similarly, the concept of excess product refers to an abundance of inventory transferred in the chain. A service in excess will strictly speaking simply be lost - based on the perishable nature of services not capable of being stored in inventory.

It should be noted that inventory might be used in the delivery of a service. This will make this type of Return process types relevant to services. The focus within services results in the inappropriateness of the inventory processes, with the outcome being that very specific inventory focused Return processes is obsolete.

The semantics related to the RETURN of service is more generalised; as opposed to the specific nature within the SCOR model to cover any return scenario. Although, the intention of the process block from this model adaptation is the return of defective services. is the concepts of Request Return Service and Deliver Return Service are used in the adapted model.

4.2.2 Combination of Make and Deliver

The combination of the Make and Deliver steps can easily be considered as one process. In the manufacturing context, the two elements are treated separately as there is a difference between the point where something is created and where it is handed over to the customer. In services, especially non-standard services, these two steps will likely be performed at the same time. Even on a semantics level, we often refer to delivery when we speak about the Make process as translated from manufacturing to services.

In analysing the Deliver process elements, it is relevant in a manufacturing concept as it focuses greatly on the material flow, packing and shipping processes related to the physical product. These processes are less relevant to services.

Barnard (2006) keeps these two process steps separate in adapting the SCOR model for services. The rationale for this separation is that even though the work may be performed and delivered at the same time, there is value in having a separate quality gate or deliberate process of handover together with invoicing and billing. These steps are then separated from the actual execution of work. From this, it can be derived that there is value in not combining the Make and Deliver steps but keeping them separate with this logic in mind. Applying this principle will mean keeping to the original model where possible and keeping the process elements.

4.2.3 Role of Semantics

Following on the previous section of not combining the Make and Deliver processes, it is necessary to review the semantics used to describe the process steps. Barnard (2006) proposes new names to the processes, to better describe the various stages through the chain. For the concept of Source, the term Request is used. This change does not make a large difference in the approach to the block, and both may be relevant in the context of services. The value of using Request is in the role of the customer. When working on the manufacturing supply chain, the general assumptions is that work is completed based on inventory levels and not on a customer request or customer initiated process (although the trend is to move to Make or Engineer to Order). In these cases, the name Source may be appropriate. In the case where the process is initiated by a request, the name Request is much more intuitive and is applicable to most service scenarios.

For the item of Make, the concept of Fulfil is used. This covers the meaning of Make but also makes the language applicable to services. The concept of Deliver is kept as is (Barnard 2006).

In summary, semantic changes to the processes of Plan, Source, Make, Deliver and Return can now be translated to: Plan, Request, Fulfil, Deliver and Return respectively.

4.2.4 Role of Inventory

The previous section changed the concept of Source to Request, thereby highlighting a further difference between manufacturing and services. In manufacturing, one deals with inventory. This implies the use of the Source process on a Level 2 process level. For SCOR, the concept of Make to Stock may simply not be applicable, as services cannot be kept as inventory.

Therefore, on a Level 2 layer of SCOR, the concept of Make to Stock is not applicable to services. The concepts of Make to Order and Engineer to Order can translate to services. Thus, one would be able to conceive the processes of Fulfil to Order and Engineer to Order.

Removing the Make to Stock process is in keeping with the principle of removing process items that are redundant or not used.

Barnard (2006) proposes expanding the Make to Order in greater granularity to make it more applicable to service; he adds the concepts of Fulfil Scheduled Service, Fulfil Unscheduled Service and Fulfil Contracted Service. Fulfil Scheduled service is the fulfilment of a service based on a customer request, which can be scheduled for a future date. An example of such a request may be a doctor's appointment. Fulfil Unscheduled Service is where the fulfilment of the service takes place without prior scheduling of the service. An example may be an emergency room patient that is attended to immediately without prior scheduling.

Fulfil to Contracted Service refers to a case where a contract is pre-agreed and is executed upon based on this contract. Barnard (2006) does not provide any further detail to the steps required by the SCOR model - but provides the concept of Scheduled, Unscheduled and Contracted services as constructs to use. Furthermore, Barnard (2006) comments that the Contracted Service concept was not executed in his model but that it shows the flexibility of the approach. In translating the concept to the existing SCOR model, the equivalent concept to Barnard's (2006) Contracted Service is Engineer to Order.

It may also refer to services where a contract is in place to trigger work that will be completed periodically, due to the contract and not due to an input by a customer. The principles of model adaptation included the concept to avoid adding new elements - to remove the risk of adding elements that overlap with elements that are already included in the model (refer section 3.6). Based on this principle, the Fulfil to Contracted Service is not adopted. In keeping with the principle of semantics, the Engineer to Order process is translated to Fulfil Engineered Service.

It is arguable whether the concept of modelling a service, using Engineer to Order or Fulfil Engineered Service, will be applicable on the type of services that are standardised and run from the back office. The process element will be kept for completeness.

The approach of removing the concept of a contracted service as proposed by Barnard (2006) does create the potential gap, where the service is not triggered by interaction with a client, but through a contractual agreement. Examples of such a scenario may be for a maintenance agreement for IT server support. In this case, we may have the situation where the server requires attention after it has become unresponsive. In this case, support is required without a contracting process as the contract is already in place. A further example may be that part of the maintenance contract requires the IT server software to be kept up to date monthly. It is proposed to keep to the current constructs introduced thus far.

In the scenario where the server requires urgent attention, this should be treated as a Fulfil Unscheduled Service, with the only difference being that the event is triggered not by the client interaction, but rather through an event that has been defined in a contract. Similarly, in the scenario where the server requires monthly updates based on a contract, that can be treated as Fulfil Scheduled Service. The difference being that the event is triggered by a contractual obligation that can be scheduled, and not through a client making an appointment.

This section has shown that the Make to Stock concept is not relevant to services. As such, the principle of removing redundant processes is used to exclude the process block. Based on the work of Barnard (2006) the concept of Make to Order, or translated to Fulfil to Order, is expanded to Fulfil Scheduled Service and Fulfil Unscheduled Service. This is in keeping with the principle of expanding the model where it can be based in other models or literature.

The differentiation of Scheduled and Unscheduled services and the impact on the management of capacity is similar to the discussions of capacity of Armistead et al. (1994) as discussed in section 2.5. The adaptation of Barnard (2006) thus assists in the approach of capacity management of chase or level strategies.

A final dimension to consider on inventory within services is that the concept of inventory is not irrelevant. There are processes where a service is delivered but this is supported through a device or inventory item. In these cases, the inventory concepts are relevant. The role of inventory is simply not as strong in the context of modelling services, as it would be in the context of manufacturing. This makes the strong focus on inventory in the SCOR model less relevant.

4.2.5 Simultaneity of Services

The concept of the simultaneity of services has been mentioned in the literature study in section 3.1.1 as well as the review of the SCOR model. The SCOR model was chosen as the approach due to its linear process model approach. The challenge in taking this approach is that services have a high dependency on the customer that may:

1) Be interacting with the supply chain at various points in the supply chain,
2) Have a bi-directional relationship to the process and
3) Have processes executing in parallel and not in a linear fashion.

The concept of parallel streams is also found in manufacturing. In large projects that typically relate to Engineer to Order, one may find that several providers or manufacturers are executing their work in parallel. The consideration here for services is that the more one moves to standardised back-office services, the more linear the services may become and the less the simultaneous execution is experienced. Simultaneity may still be relevant, as it is also in manufacturing, but a greater trend towards linearity is assumed, as services move closer towards standardisation.

4.2.6 Information Flow

The concept of the customer interacting at multiple points in the process and the bidirectional nature of the customer interaction requires elaboration. To address these scenarios of bi-directional information flow as well as customer interaction at various points in the supply chain, it is proposed to keep to the linear approach to modelling. The Service Supply Chain is to be modelled from the approach of a value chain. This should be modelled from right to left in the diagram. The only point where the flow should go from left to right is if the return block is used.

If an activity is to be performed and handed back to the party that the service moved from, this party should be modelled before and after the step where the activity is performed. This should not be confused with the initiation of a process or request. Bi-directional flow exists in the SCOR model, as it is designed for manufacturing. A customer request or order moves into the supply chain from right to left. However, the SCOR model only depicts the flow of goods that follows this order; unless it is triggered to flow from right to left.

In the case of services, the item flowing back toward the customer will be a service, not a physical product. The service will most likely be modelled as a proxy to inventory. This flow back to the customer may in fact be the very original request item the customer addressed to the service supply chain. This is illustrated by way of example: Assume a service where a customer contacts a call centre that refers the call to a back office, which resolves the problem and notifies the call centre that they should contact the customer to confirm resolution of the problem. In this example, the flow into the chain (right to left) as well as the return process (left to right) is the flow of the call reference. This is illustrated in Figure 16.

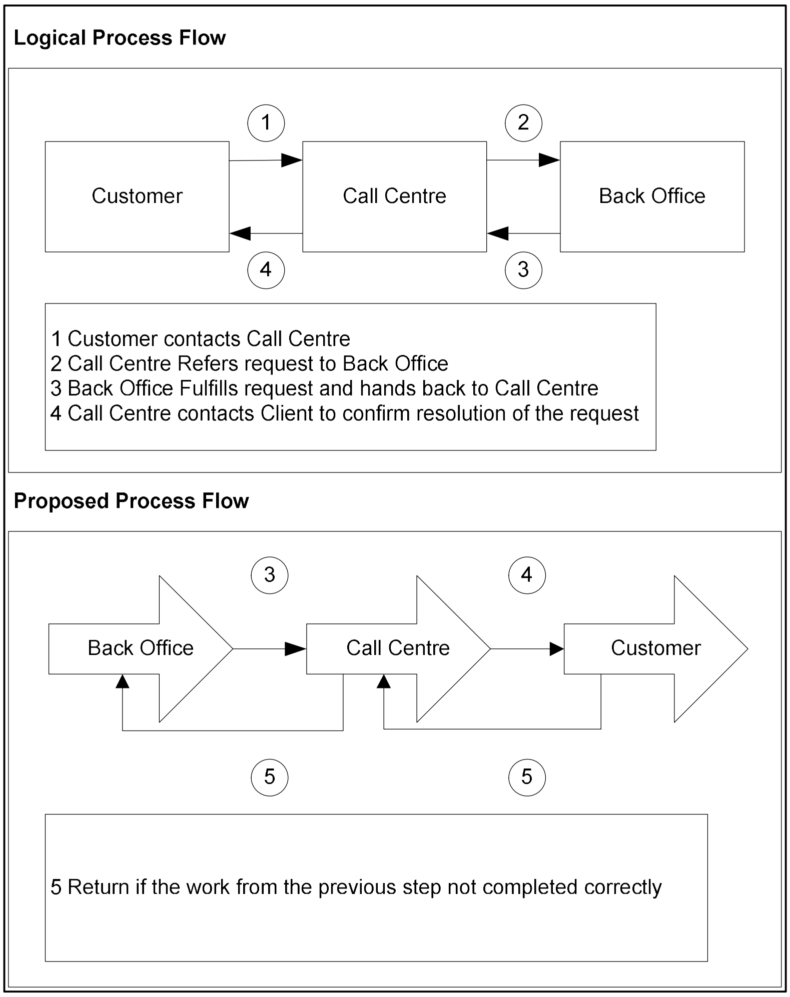

Figure 16: Process Flow Convention

In this case, where a customer is required to add value to the process during the process, the customer should then be modelled as a role player in that step of the chain. The proposed process flow may seem less compact, but it gives the opportunity to utilise the elements of supply chain management better - as it places a focus on identifying steps that may be superfluous. This interaction should not be simply providing information; this type of interaction will not be unique to services, as it may exist in manufacturing as well. The concept of introducing the customer in the actual chain should be where the customer takes an active part in adding value to the service.

4.2.7 Summary

The previous section has provided the basis of the adapted SCOR model for standardised back-office services.

Based on the above changes, an adapted SCOR model is derived with the process blocks shown in Figure 17.

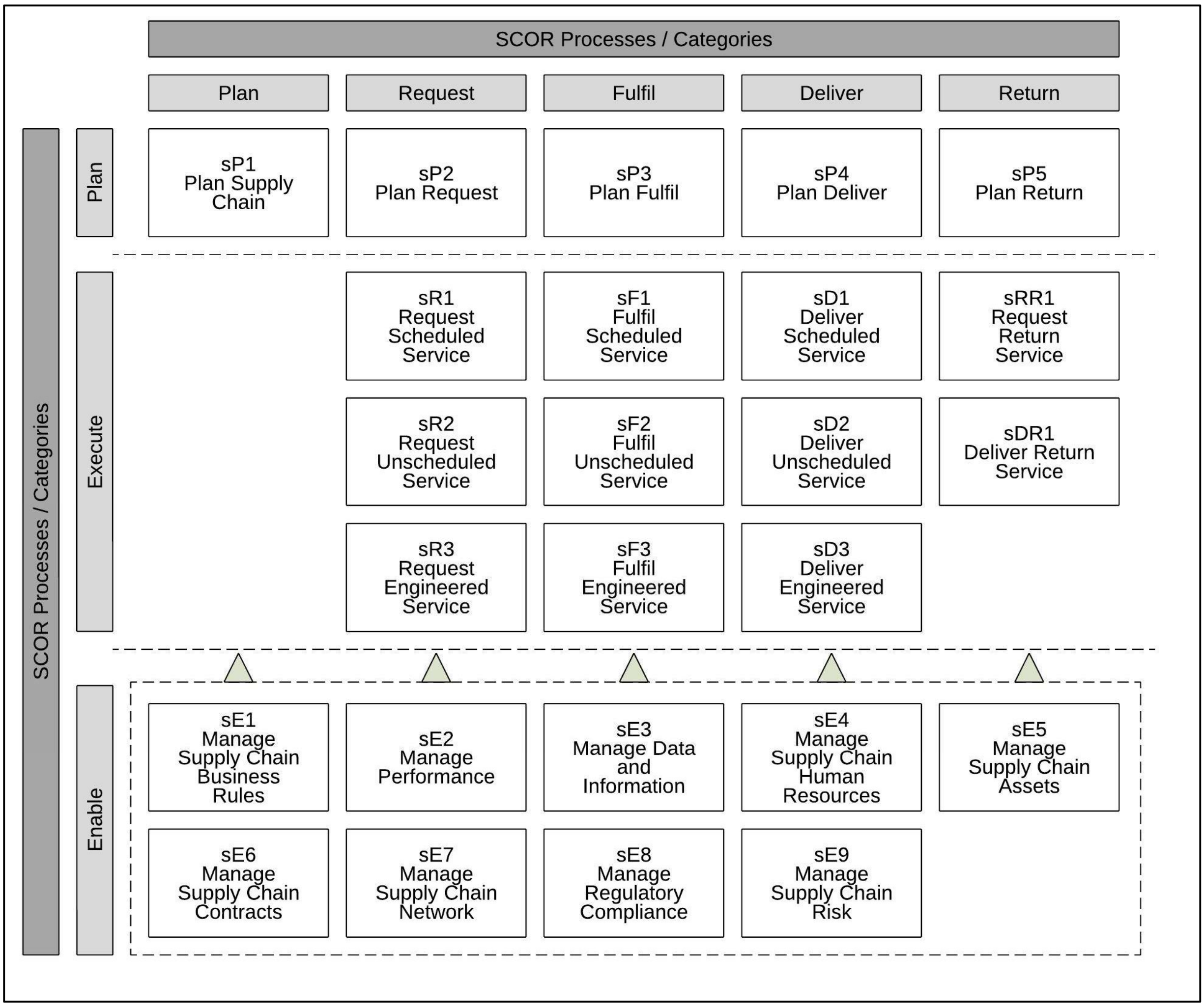

Figure 17: Adapted Service SCOR Process Elements

The following section will elaborate on the newly designed SCOR model and provide the Level 2 changes to these items.

4.3 Review of Processes on Element Level

The previous section analysed the changes to the high-level processes of the SCOR model for standardised back-office services. This section will analyse each of the defined process elements of the adapted SCOR model, in line with the principles defined for the adapted supply chain. Summarizing the major changes to each category of process element does this. The outputs of the reviewed SCOR model are provided in Appendix A.

The approach taken in adapting the SCOR processes was to first apply the major changes related to a supply chain for services, to the original SCOR model. The output of these changes then resulted in the adapted service SCOR model process elements shown in Figure 17.

The process elements shown in Figure 17 were then each analysed together with sub-processes (Level 3) directly related to the process element being considered. From this, each description is analysed with the decision to perform on or more of the following options:

1) Remove the process element,
2) Change process reference of process element (e.g. sS2 to sR1),
3) Change the title of the process element,
4) Keeping the process description as is,
5) Change the description of the process element through semantics,
6) Remove references to product specific concepts,
7) Add concepts specific to services, and
8) Provide a totally new description.

The approach is shown in Figure 18. In line with the principles established in Chapter 3 in adapting the SCOR model, the last two steps of adding new concepts or to provide a new description are avoided as far as possible to keep to the original integrity of the model. The preferred form of adaptation is either through maintaining the original description, or to use semantic changes. A high use of keeping to the original model or keeping to semantic changes will further support the hypothesis that the SCOR model is applicable to a certain subset of services, namely, standardised back-office services, without major modification.

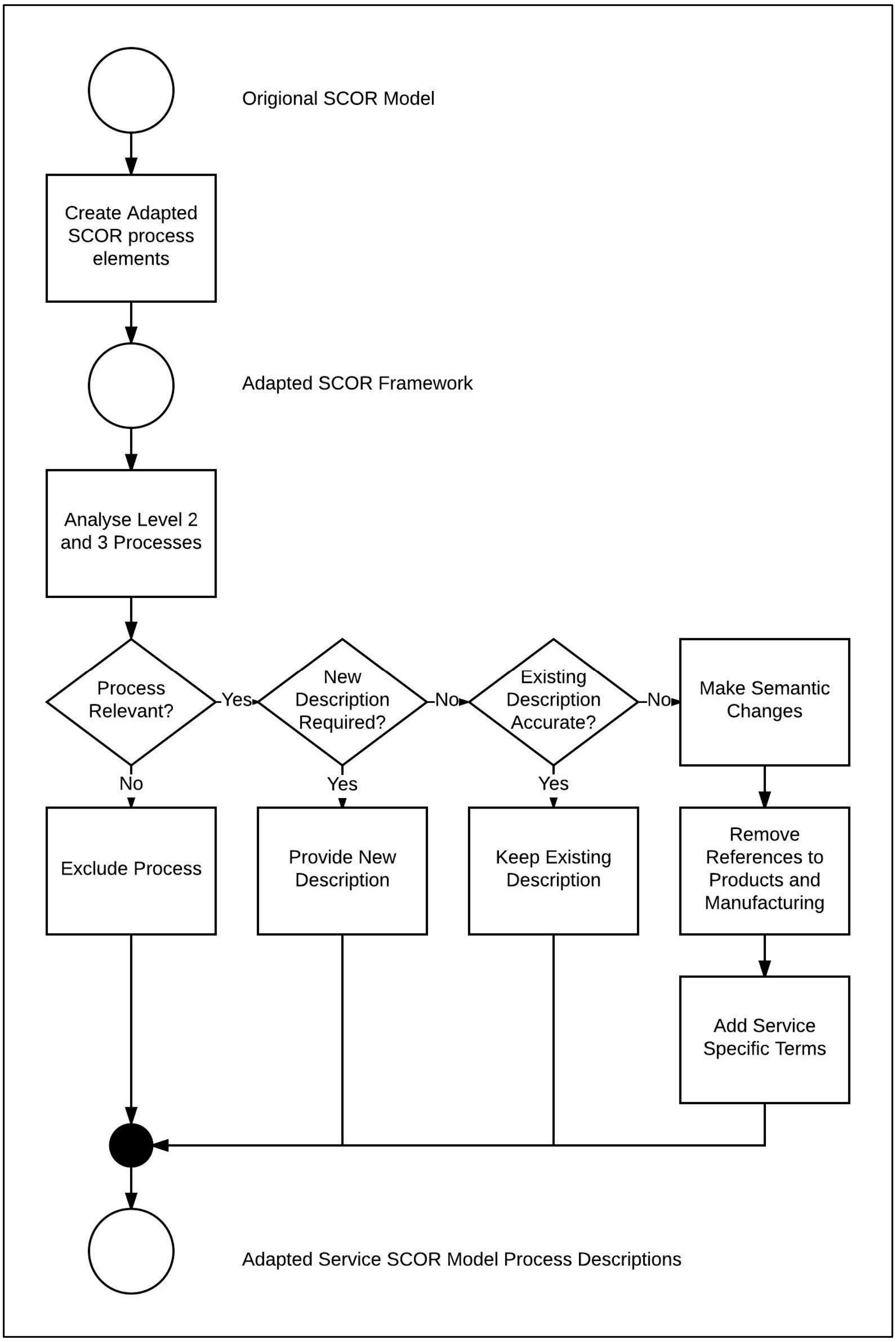

Figure 18: SCOR Process Adaptation Approach

4.3.1 Plan

The PLAN process blocks are relevant without many changes to the standardised back-office services being considered. Changes to the Plan processes lie in semantics. Words like “production” and “material” change to “services” and “resources”, related to services to make the block more applicable to services.

Semantics are changed in the Plan Return process to only cover unanticipated return requirements; these are due to insufficient completion of the previous step in the supply chain, as has been discussed in previous sections of this chapter.

Table 12 summarises the changes made in adapting the Plan processes. The changes are mostly semantic in nature and are generally suitable in the context of services without any major changes to the processes.

Table 12: Plan Process Analysis

Process Reference	Origional Process Name	Process Removed	Title Change	New Process Reference	New Process Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
sP1	Plan Supply Chain			sP1	Plan Supply Chain	x				
sP1.1	Identify, Prioritize and Aggregate Supply Chain…			sP1.1	Identify, Prioritize and Aggregate Supply Chain…		x	x		
sP1.2	Identify, Prioritize and Aggregate Supply Chain…			sP1.2	Identify, Prioritize and Aggregate Supply Chain…	x				
sP1.3	Balance Supply Chain Resources with SC Req…			sP1.3	Balance Supply Chain Resources with SC Req…		x	x	x	
sP1.4	Establish and Communicate Supply Chain Plans			sP1.4	Establish and Communicate Supply Chain Plans	x				
sP2	Plan Source		x	sP2	Plan Request	x				
sP2.1	Identify, Prioritize and Aggregate Product Req…			sP2.1	Identify, Prioritize and Aggregate Product Req…				x	
sP2.2	Identify, Assess and Aggregate Product Resources			sP2.2	Identify, Assess and Aggregate Product Resources			x		
sP2.3	Balance Product Resources with Product Req…			sP2.3	Balance Product Resources with Product Req…	x				
sP2.4	Establish Sourcing Plans			sP2.4	Establish Sourcing Plans	x				
sP3	Plan Make		x	sP3	Plan Fulfil		x			
sP3.1	Identify, Prioritize and Aggregate Production Req…		x	sP3.1	Identify, Prioritize and Aggregate Production Req…			x		
sP3.2	Identify, Assess and Aggregate Production Res…		x	sP3.2	Identify, Assess and Aggregate Production Res…			x		
sP3.3	Balance Production Resources with Production…		x	sP3.3	Balance Production Resources with Production…				x	
sP3.4	Establish Production Plans		x	sP3.4	Establish Production Plans					
sP4	Plan Deliver			sP4	Plan Deliver	x				
sP4.1	Identify, Prioritize and Aggregate Delivery Req…			sP4.1	Identify, Prioritize and Aggregate Delivery Req…		x			
sP4.2	Identify, Assess and Aggregate Delivery Res…			sP4.2	Identify, Assess and Aggregate Delivery Res…		x			
sP4.3	Balance Delivery Resources and Capabilities…			sP4.3	Balance Delivery Resources and Capabilities…	x				
sP4.4	Establish Delivery Plans			sP4.4	Establish Delivery Plans	x				
sP5	Plan Return			sP5	Plan Return			x		
sP5.1	Assess and Aggregate Return Requirements			sP5.1	Assess and Aggregate Return Requirements		x			
sP5.2	Identify, Assess and Aggregate Return Res…			sP5.2	Identify, Assess and Aggregate Return Res…		x			
sP5.3	Balance Return Resources with Return Req…			sP5.3	Balance Return Resources with Return Req…	x				
sP5.4	Establish and Communicate Return Plans			sP5.4	Establish and Communicate Return Plans	x				

4.3.2 Request

On the Source to Request change, the words are kept very similar with changes mostly made on a semantic level. On Engineer to Order the word “service” already exists. The biggest change here is the omission of references to physical material while keeping references to services. Changes to semantics include references to “Stock Keeping Unit (SKU)”, changed to “Service Portfolio Item” and “Changed Parts Providers” to “Service Providers”.

In terms of Scheduled vs. Unscheduled Fulfilment, a change is made in Unscheduled Fulfilment, as the service cannot be pre-scheduled. Scheduling takes place based on the newly received demand to which the supply chain must respond as soon as possible. This is typically for a repair or maintenance process. The Source Make to Order process is used as the basis for both the Scheduled and Unscheduled process.

The Transfer Product processes in the Sourcing or Request processes was removed as it is very specific to the handling of inventory, which is less relevant in the case of services.

Table 13 provides a summary of the changes made to adapt the SCOR model to services for the Request process. Most changes are of a semantic nature.

Table 13: Request Process Analysis

Process Reference	Origional Process Name	Process Removed	Title Change	New Process Reference	New Process Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
sS1	Source Stocked Product	x								
sS2	Source Make-to-Order Product		x	sR1	Request Scheduled Service		x	x	x	
sS2.1	Schedule Product Deliveries		x	sR1.1	Schedule Service Deliveries		x	x	x	
sS2.2	Receive Product		x	sR1.2	Receive Service		x			
sS2.3	Verify Product		x	sR1.3	Verify Service		x			
sS2.4	Transfer Product	x								
sS2.5	Authorize Supplier Payment			sR1.4	Authorize Supplier Payment		x			
sS2 S	Source Make-to-Order Product		x	sR2	Request Unscheduled Service		x	x	x	
sS2.1	Schedule Product Deliveries		x	sR2.1	Schedule Service Deliveries		x	x	x	
sS2.2	Receive Product		x	sR2.2	Receive Service		x			
sS2.3	Verify Product		x	sR2.3	Verify Service		x			
sS2.4	Transfer Product	x								
sS2.5	Authorize Supplier Payment			sR2.4	Authorize Supplier Payment		x			
sS3	Source Engineer-to-Order Product		x	sR3	Request Engineered Service		x	x		
sS3.1	Identify Sources of Supply			sR3.1	Identify Sources of Supply		x			
sS3.2	Select Final Supplier and Negotiate			sR3.2	Select Final Supplier and Negotiate		x	x	x	
sS3.3	Schedule Product Deliveries		x	sR3.3	Schedule Service Deliveries		x			
sS3.4	Receive Product		x	sR3.4	Receive Service		x			
sS3.5	Verify Product		x	sR3.5	Verify Service		x			
sS3.6	Transfer Product	x								
sS3.7	Authorize Supplier Payment			sR3.6	Authorize Supplier Payment		x			

4.3.3 Fulfil

In reviewing the fulfil processes, elements associated with the releasing of sub-assemblies, as well as the transfer of stock to staging to transferring product, are removed.

Scheduled Fulfilment is differentiated in the modelling to Unscheduled Fulfilment, as not all the required services may be available for Unscheduled services - due to the nature of the event being unscheduled. In this case, the scheduling of the activities need to be fulfilled as far as possible and steps for waiting for the supporting services must be available. The process must thus accommodate that the service may be executed to a certain point with the ability to halt the service execution with some form of storing the service. This may be the case where there is a repair process and various services are used as part of repair, but where the repair actually requires further services to complete the process. In this case, the request should be able to be kept in a holding or pending status while waiting for the further services to be delivered.

The Make to Order process is used as the basis for both the Scheduled and Unscheduled processes. Items related specifically to material or inventory handling are removed. Table 14 summarizes the changes that have been made to each of the processes.

Most of the changes are semantic in nature and includes dropping descriptions related to products. New descriptions are used on two processes where the description related to manufacturing is very specialised. A simplified description for services is appropriate without changing the integrity of the overall model.

Table 14: Fulfil Process Analysis

Process Reference	Origional Process Name	Process Removed	Title Change	New Process Reference	New Process Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
sM1	Make-to-Stock	x								
sM2	Make-to-Order		x	sF1	Fulfil Scheduled Service		x	x	x	
sM2.1	Schedule Production Activities		x	sF1.1	Schedule Fulfilment Activities					x
sM2.2	Issue Sourced/In-Process Product	x								
sM2.3	Produce and Test		x	sF1.2	Fulfill and Test		x	x		
sM2.4	Package	x								
sM2.5	Stage Finished Product	x								
sM2.6	Release Finished Product to Deliver		x	sF1.5	Release Finished Service to Deliver		x	x		
sM2.7	Waste Disposal	x								
sM2	Make-to-Order		x	sF2	Fulfil Unscheduled Service		x	x	x	
sM2.1	Schedule Production Activities		x	sF2.1	Schedule Fulfilment Activities		x	x	x	
sM2.2	Issue Sourced/In-Process Product	x								
sM2.3	Produce and Test		x	sF2.2	Fulfill and Test		x	x		
sM2.4	Package	x								
sM2.5	Stage Finished Product	x								
sM2.6	Release Finished Product to Deliver		x	sF2.5	Release Finished Service to Deliver		x	x		
sM2.7	Waste Disposal	x								
sM3	Engineer-to-Order		x	sF3	Fulfil Engineered Service		x	x		
sM3.1	Finalize Production Engineering		x	sF3.1	Finalize Fulfilment Engineering		x	x		
sM3.2	Schedule Production Activities		x	sF3.2	Schedule Fulfilment Activities					x
sM3.3	Issue Sourced/In-Process Product	x								
sM3.4	Produce and Test		x	sF3.4	Fulfill and Test		x	x	x	
sM3.5	Package	x								
sM3.6	Stage Finished Product		x	sF3.6	Release Finished Services to Deliver		x	x		
sM3.7	Release Product to Deliver	x								
sM3.8	Waste Disposal	x								

4.3.4 Deliver

On the Deliver process, references to material flow or staging is removed. For Install, the Fulfil service is used and will include the quality checks by, or with the customer. For Unscheduled service, the reservation of capacity will most likely be the reprioritisation of capacity as it is arguable that a well-run supply chain will not have an abundance of excess capacity.

The Deliver Make to Order process is used as the basis for both the Scheduled and Unscheduled processes. Items related specifically to material or inventory handling are removed. Table 15 summarizes the changes that have been made to each of the processes.

The majority of changes are of a semantic nature and / or by dropping concepts related to products.

Table 15: Deliver Process Analysis

Process Reference	Origional Process Name	Process Removed	Title Change	New Process Reference	New Process Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
sD1	Deliver Stocked Product	x								
sD2	Deliver Make-to-Order Product		x	sD1	Deliver Scheduled Service		x	x		
sD2.1	Process Inquiry and Quote			sD1.1	Process Inquiry and Quote	x				
sD2.2	Receive, Configure, Enter and Validate Order			sD1.2	Receive, Configure, Enter and Validate Order		x			
sD2.3	Reserve Inventory and Determine Delivery Date		x	sD1.3	Reserve Capacity and Determine Delivery Date	x				
sD2.4	Consolidate Orders	x								
sD2.5	Build Loads	x								
sD2.6	Route Shipments	x								
sD2.7	Select Carriers and Rate Shipments	x								
sD2.8	Receive Product from Source or Make		x	sD1.4	Receive Services from Source or Fulfil		x	x		
sD2.9	Pick Product	x								
sD2.10	Pack Product	x								
sD2.11	Load Product & Generate Shipping Docs	x								
sD2.12	Ship Product	x								
sD2.13	Receive and verify Product by Customer	x								
sD2.14	Install Product		x	sD1.5	Execute Service		x	x		
sD2.15	Invoice			sD1.6	Invoice		x			
sD2	Deliver Make-to-Order Product		x	sD2	Deliver Scheduled Service		x	x		
sD2.1	Process Inquiry and Quote			sD2.1	Process Inquiry and Quote	x				
sD2.2	Receive, Configure, Enter and Validate Order			sD2.2	Receive, Configure, Enter and Validate Order		x			
sD2.3	Reserve Inventory and Determine Delivery Date		x	sD2.3	Reserve Capacity and Determine Delivery Date		x		x	
sD2.4	Consolidate Orders	x								
sD2.5	Build Loads	x								
sD2.6	Route Shipments	x								
sD2.7	Select Carriers and Rate Shipments	x								
sD2.8	Receive Product from Source or Make		x	sD2.4	Receive Services from Source or Fulfil		x	x		
sD2.9	Pick Product	x								
sD2.10	Pack Product	x								
sD2.11	Load Product & Generate Shipping Docs	x								
sD2.12	Ship Product	x								
sD2.13	Receive and verify Product by Customer	x								
sD2.14	Install Product		x	sD2.5	Execute Service		x	x		
sD2.15	Invoice			sD2.6	Invoice		x			
sD3	Deliver Engineer-to-Order Product		x	sD3	Deliver Engineered Service		x	x		
sD3.1	Obtain and Respond to RFP/RFQ			sD3.1	Obtain and Respond to RFP/RFQ	x				
sD3.2	Negotiate and Receive Contract			sD3.2	Negotiate and Receive Contract		x			
sD3.3	Enter Order, Commit Resources & Launch Program			sD3.3	Enter Order, Commit Resources & Launch Program		x	x		
sD3.4	Schedule Installation		x	sD3.4	Schedule Execution		x			
sD3.5	Build Loads	x								
sD3.6	Route Shipments	x								
sD3.7	Select Carriers & Rate Shipments	x								
sD3.8	Receive Product from Source or Make		x	sD3.5	Receive Services from Request or Fulfil		x	x		
sD3.9	Pick Product	x								
sD3.10	Pack Product	x								
sD3.11	Load Product & Generate Shipping Docs	x								
sD3.12	Ship Product	x								
sD3.13	Receive and verify Product by Customer	x								
sD3.14	Install Product		x	sD3.6	Execute Service		x	x		
sD3.15	Invoice			sD3.7	Invoice		x	x		
sD4	Deliver Retail Product	x								

4.3.5 Return

The return process is limited to defective products and any reference to material handling or flow is removed. All return processes are collapsed into one generic Return process. The use of Return may be limited, but it is still useful to include the process, as there are scenarios where the service will have to be returned because the work was not sufficiently completed. This is specific to services of a standardised back-office nature. This does not mean that other categories of service would not benefit from a concept of return in the process model; it is relevant to services. This will be explored further in the case study in the following chapter where the concept will be tested.

The process elements of Discounts and Refunds are removed. In services it is more likely that the concept of damages will be applicable, which is covered in Return Governance Risk and Compliance.

Disposition Costs are removed as it is very much related to physical material and dimensions related to physical material.

A new description is given for the Return Defective Service, as the original description is not easily applicable to services. In addition, the description of services is simplified and has less of a dependency on the physical shipping of a good.

Table 16: Return Process Analysis

Process Reference	Origional Process Name	Process Removed	Title Change	New Process Reference	New Process Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
sSR1	Source Return Defective Product		x	sRR1	Request Return Service		x	x		
sSR1.1	Identify Defective Product Condition		x	sRR1.1	Identify Defective Service Condition		x			
sSR1.2	Disposition Defective Product		x	sRR1.2	Disposition Defective Service		x			
sSR1.3	Request Defective Product Return Authorization		x	sRR1.3	Request Defective Service Return Authorization		x	x		
sSR1.4	Schedule Defective Product Shipment	x								
sSR1.5	Return Defective Product		x	sRR1.4	Return Defective Service					x
sDR1	Deliver Return Defective Product		x	sDR1	Deliver Return Service		x	x		
sDR1.1	Authorize Defective Product Return		x	sDR1.1	Authorize Defective Service Return		x	x		
sDR1.2	Schedule Defective Return Receipt									
sDR1.3	Receive Defective Product (includes verify)		x	sDR1.2	Receive Defective Service (includes verify)		x	x		
sDR1.4	Transfer Defective Product		x	sDR1.4	Transfer Defective Service		x			
sSR2	Return MRO Product	x								
sDR2	Deliver Return MRO Product	x								
sSR3	Source Return Excess Product	x								
sDR3	Deliver Return Excess Product	x								

4.3.6 Enable

All the enable processes were found to be applicable after translation. Most of the processes are used without any changes. Table 17 summarises the changes made on each of the processes. The Enable processes are very applicable without major changes in its current form.

Table 17: Enable Process Analysis

Process Reference	Origional Process Name	Process Removed	Title Change	New Process Reference	New Process Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
sE1	Manage Supply Chain Business Rules			sE1	Manage Supply Chain Business Rules			x		
sE1.1	Gather Business Rule Requirements			sE1.1	Gather Business Rule Requirements	x				
sE1.2	Interpret Business Rule Requirement			sE1.2	Interpret Business Rule Requirement	x				
sE1.3	Document Business Rule			sE1.3	Document Business Rule	x				
sE1.4	Communicate Business Rule			sE1.4	Communicate Business Rule	x				
sE1.5	Release/Publish Business Rule			sE1.5	Release/Publish Business Rule		x			
sE1.6	Retire Business Rule			sE1.6	Retire Business Rule	x				
sE2	Manage Performance			sE2	Manage Performance			x		
sE2.1	Initiate Reporting			sE2.1	Initiate Reporting	x				
sE2.2	Analyze Reports			sE2.2	Analyze Reports	x				
sE2.3	Find Root Causes			sE2.3	Find Root Causes	x				
sE2.4	Prioritize Root Causes			sE2.4	Prioritize Root Causes	x				
sE2.5	Develop Corrective Actions			sE2.5	Develop Corrective Actions			x		
sE2.6	Approve & Launch			sE2.6	Approve & Launch	x				
sE3	Manage Data and Information			sE3	Manage Data and Information			x		
sE3.1	Receive Maintenance Request			sE3.1	Receive Maintenance Request	x				
sE3.2	Determine/Scope Work			sE3.2	Determine/Scope Work	x				
sE3.3	Maintain Content/Code			sE3.3	Maintain Content/Code	x				
sE3.4	Maintain Access			sE3.4	Maintain Access	x				
sE3.5	Publish Information			sE3.5	Publish Information	x				
sE3.6	Verify Information			sE3.6	Verify Information	x				
sE4	Manage Supply Chain Human Resources			sE4	Manage Supply Chain Human Resources	x				
sE4.1	Identify Skills/Resource Requirement			sE4.1	Identify Skills/Resource Requirement	x				
sE4.2	Identify Available Skills/Resources			sE4.2	Identify Available Skills/Resources	x				
sE4.3	Match Skills/Resources			sE4.3	Match Skills/Resources	x				
sE4.4	Determine Hiring/Redeployment			sE4.4	Determine Hiring/Redeployment	x				
sE4.5	Determine Training/Education			sE4.5	Determine Training/Education	x				
sE4.6	Approve, Prioritize and Launch			sE4.6	Approve, Prioritize and Launch		x			
sE5	Manage Supply Chain Assets			sE5	Manage Supply Chain Assets			x		
sE5.1	Schedule Asset Management Activities			sE5.1	Schedule Asset Management Activities	x				
sE5.2	Take Asset Off-line			sE5.2	Take Asset Off-line	x				
sE5.3	Inspect and Troubleshoot			sE5.3	Inspect and Troubleshoot	x				
sE5.4	Install and Configure			sE5.4	Install and Configure	x				
sE5.5	Clean, Maintain and Repair			sE5.5	Clean, Maintain and Repair	x				
sE5.6	Decommission and Dispose			sE5.6	Decommission and Dispose	x				
sE5.7	Inspect Maintenance			sE5.7	Inspect Maintenance	x				
sE5.8	Reinstate Asset			sE5.8	Reinstate Asset	x				
sE6	Manage Supply Chain Contracts			sE6	Manage Supply Chain Contracts		x	x		
sE6.1	Receive Contract/Contract Updates			sE6.1	Receive Contract/Contract Updates	x				
sE6.2	Enter and Distribute Contract			sE6.2	Enter and Distribute Contract	x				
sE6.3	Activate/Archive Contract			sE6.3	Activate/Archive Contract	x				
sE6.4	Review Contractual Performance			sE6.4	Review Contractual Performance	x				
sE6.5	Identify Performance Issues/Opportunities			sE6.5	Identify Performance Issues/Opportunities	x				
sE6.6	Identify Resolutions/Improvements			sE6.6	Identify Resolutions/Improvements	x				
sE6.7	Select, Prioritize and Distribute Resolutions			sE6.7	Select, Prioritize and Distribute Resolutions	x				
sE7	Manage Supply Chain Network			sE7	Manage Supply Chain Network	x				
sE7.1	Select Scope and Organization			sE7.1	Select Scope and Organization	x				
sE7.2	Gather Input and Data			sE7.2	Gather Input and Data	x				
sE7.3	Develop Scenarios			sE7.3	Develop Scenarios	x				
sE7.4	Model/Simulate Scenarios			sE7.4	Model/Simulate Scenarios	x				
sE7.5	Project Impact			sE7.5	Project Impact	x				
sE7.6	Select and Approve			sE7.6	Select and Approve	x				
sE7.7	Develop Change Program			sE7.7	Develop Change Program	x				
sE7.8	Launch Change Program			sE7.8	Launch Change Program	x				
sE8	Manage Regulatory Compliance			sE8	Manage Regulatory Compliance	x				
sE8.1	Monitor Regulatory Entities			sE8.1	Monitor Regulatory Entities	x				
sE8.2	Assess Regulatory Publications			sE8.2	Assess Regulatory Publications	x				
sE8.3	Identify Regulatory Deficiencies			sE8.3	Identify Regulatory Deficiencies	x				
sE8.4	Define Remediation			sE8.4	Define Remediation	x				
sE8.5	Verify/Obtain License			sE8.5	Verify/Obtain License	x				
sE8.6	Publish Remediation			sE8.6	Publish Remediation	x				
sE9	Manage Supply Chain Risk			sE9	Manage Supply Chain Risk	x		x		
sE9.1	Establish Context			sE9.1	Establish Context	x				
sE9.2	Identify Risk Events			sE9.2	Identify Risk Events	x				
sE9.3	Quantify Risks			sE9.3	Quantify Risks	x				
sE9.4	Evaluate Risks			sE9.4	Evaluate Risks	x				
sE9.5	Mitigate Risk			sE9.5	Mitigate Risk	x				

4.3.7 Summary

The review of the process elements has found that the SCOR processes can easily be made applicable to standardised back-office services through the use of semantics. Items very specific to inventory can be excluded. The process additions have been in the areas of handling the Unscheduled Service and the complexity in the lack of inventory to act as a buffer.

The process elements, as described in SCOR, are thus very relevant to standardised back-office services through minor changes through semantics or omission. The following section will elaborate on the performance metrics that are linked to the adapted processes.

4.4 Review of Performance Metrics on Element Level

In approaching the performance measures, each of them linked to the process elements up to Level 2 are combined. The first portion of the analysis was to analyse the processes with the most recurrences across all the processes. This was discussed in a section considering the most used performance measures.

This was followed by an analysis of the performance measures with lower recurrences in their process categories. Performance measures that had not been listed, but form part of the Level 1 metrics, are added.

It is useful to note the principle and goal of including the performance measures. The performance measures are included to build a model that can be used to test with a test group to determine the relevance and utility of the adapted SCOR model. One of the major valuable contributions of the SCOR model is the ability to provide the user of the model with quick access to typical performance measures. To show the value to a test group of such a model, the test group must have measures available to them. The idea is thus not to provide an all-encompassing set of measures; the idea is to provide sufficient measures for a test group to derive their own set of measures that may be relevant to them.

Following the above approach to identifying the measures, each measure description is evaluated according the following criteria:

1) Remove the metric element,
2) Change the title of the metric element,
3) Keeping the metric description as is,
4) Change the metric of the process element through semantics,
5) Remove references to product specific concepts,
6) Add concepts specific to services, and
7) Provide a totally new description.

The preference is to adapt the model using semantics and / or removing concepts related to products and manufacturing. This is in line with the approach established in Chapter 3, of adapting the SCOR model in such a way to keep the integrity of the original model.

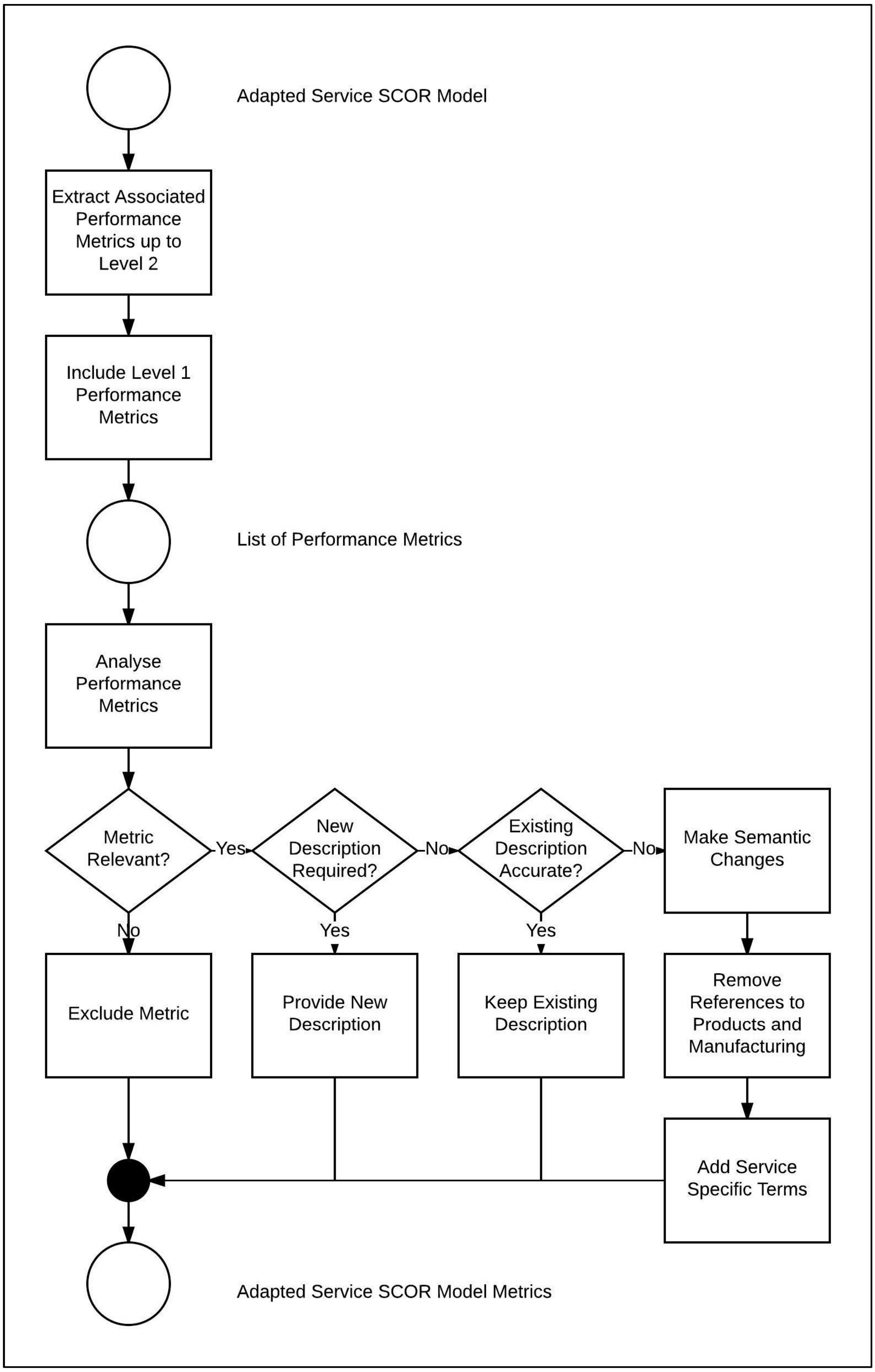

Figure 19: SCOR Metric Adaptation Approach

4.4.1 Highly Used Performance Measures

The approach to analysing performance measures was to identify the most frequently used performance measures in the process elements considered. The highest number of recurrences are from:

1) AM.1.2 Return on Supply Chain Fixed Assets (15 recurrences),
2) AM.1.3 Return on Working Capital (15 recurrences),
3) RS.1.1 Order Fulfilment Cycle Time (14 recurrences),
4) AM.1.1 Cash-To-Cash Cycle Time (11 recurrences), and
5) RL.1.1 Perfect Order Fulfilment (9 recurrences)

Although the Return on Supply Chain Fixed Assets is relevant to most of the processes, and can easily be translated for services, the value of this measure may not always be relevant. The trend is for services to move away from having fixed assets in fulfilling the service. Although, the measure is relevant to other sectors of services where the service is delivered through the application of a large capital expenditure. This measure is thus highly dependent on the nature of the service.

For Return on Working Capital the formula provided in the SCOR model can be used; the concept of Inventory is removed from the formula. Services could use inventory for the service to be delivered, but this will more than likely be associated with the repair process. The measure is kept by simply removing references to inventory.

In discussing Cash-To-Cash, the definition given is relevant to the standardised back-office services without further adaptation.

Perfect Order Fulfilment introduces two interesting dimensions. The first is that of damage; a service can arguably not be damaged - it will simply not meet the required specification or criteria. The second is that of quantity; services will most likely be for a quantity of one for each order. There may be cases for standardised processes, where there may be one order to perform a service on multiple instances; an example will be a software upgrade to many personal computers. Here, it would depend on perspective. One could say the activity is one activity. But, if the request is to upgrade 100 personal computers, and the work is done on only 90 of these computers, the order will not be perfectly fulfilled based on the quantity variation. Quantity is thus a relevant concept in the context of standardised back-office services.

Therefore, the top five processes associated with the reviewed SCOR processes are all valid for services and can be easily translated for services.

4.4.2 Cost Metrics

The following sections will consider the metrics, which were found less frequently in the processes. The metrics were analysed and are included in the study to improve the usability of the adapted service SCOR model - when applied to two facilitated walk-throughs. A summary of the analysis of the various elements is provided in Table 18.

The planning cost metrics is translated directly with minor changes to semantics or removal of references to inventory or inventory flow. Not all references to materials are removed, as services may still require physical products or material in the delivery of the service.

Sourcing measures related to cost that refer to movement of material are excluded. While the concept of delivering the service at a place of use, is kept. This is done because it may be a requirement that the service be delivered at a specific location. This is not associated to the tangible deliverable but may be because collaboration is required. This collaboration could be with other service providers, or where the service is applied to a location or asset at a certain location (e.g. maintenance of an expensive machine that cannot be moved). Again, the concept of inventory is kept, although its use is decreased, as there may be situations where inventory is used in the delivery of the service; although it is not as prominent as with manufacturing.

For Material, Landed Cost, the concept is translated to Service Acquired Cost. The concepts are kept the same, as translations may be found for the concepts from the original SCOR model. On Risk and Compliance, the compliance is not related to specific material handling risks, but rather related to risk of non-delivery of the service as well as damages that may be caused in the execution of the service.

Fulfilment Costs within the sets of measures, overlap with the measures related to the production costs within the cost measures. This is with the exception that the fulfilment measures include material handling measures. With the removal of the material handling measures, the fulfilment measures look very similar to the production measures and we thus have duplication. The fulfilment measures are removed to avoid confusion because the measure definitions overlap greatly with the removal of the inventory elements.

There is one case for the use of the fulfilment measures in services - the Fulfilment Cost is similar to the total cost of the service. The only difference would be if the service were produced based on some Intellectual Property and where this Intellectual Property carries some value, like a licensing value. In this case, Intellectual Property can be considered as a stock of a very special nature in that this stock cannot be depleted through use, as is the case with normal stock or inventory.

The Order Fulfilment costs are taken to overlap many of the previous costs. Nevertheless, it includes costs specific to fulfilling a physical customer order, which may be relevant to a service but in a very limited extent, as most of the concepts are associated to material handling. As such, this set of metrics are excluded from the Adapted SCOR model as it creates a high degree of duplication.

The metrics removed are primarily related to duplication of measures with the removal of the material handling processes. Further measures removed are associated to material handling. Table 18 contains a summary of the analysis of the metrics and shows that most of the changes relate to semantics, no change or removal of product related concepts.

Table 18: Cost Metrics Analysis

Metric Reference	Metric Process Name	Metric Removed	Duplicate	Title Change	New Metric Reference	New Metric Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
CO.1.001	Total Cost to Serve				CO.1.001	Total Cost to Serve		x			
CO.2.001	Planning Cost				CO.2.001	Planning Cost		x			
CO.3.001	Planning Labor Cost				CO.3.001	Planning Labor Cost	x				
CO.3.002	Planning Automation Cost				CO.3.002	Planning Automation Cost	x				
CO.3.003	Planning Property, Plant and Equipment Cost				CO.3.003	Planning Property, Plant and Equipment Cost	x				
CO.3.004	Planning GRC and Overhead Cost				CO.3.004	Planning GRC and Overhead Cost	x				
CO.2.002	Sourcing Cost			x	CO.2.002	Request Cost		x	x		
CO.3.005	Sourcing Labor Cost			x	CO.3.005	Request Labor Cost		x	x		
CO.3.006	Sourcing Automation Cost			x	CO.3.006	Request Automation Cost	x				
CO.3.007	Sourcing Property, Plant and Equipment Cost			x	CO.3.007	Request Property, Plant and Equipment Cost		x			
CO.3.008	Sourcing GRC, Inventory and Overhead Cost			x	CO.3.008	Request GRC, Inventory and Overhead Cost	x				
CO.2.003	Material Landed Cost			x	CO.2.003	Service Acquisition Cost		x	x		
CO.3.009	Purchased Materials Cost			x	CO.3.009	Purchased Service Cost		x			
CO.3.010	Material Transportation Cost			x	CO.3.010	Service Transportation Cost					x
CO.3.011	Material Customs, Duties, Taxes and Tariffs Cost			x	CO.3.011	Service Customs, Duties, Taxes and Tariffs Cost		x	x		
CO.3.012	Material Risk and Compliance Cost			x	CO.3.012	Service Risk and Compliance Cost		x	x		
CO.2.004	Production Cost			x	CO.2.004	Service Fulfillment Cost		x	x		
CO.3.014	Production (Direct) Labor Cost			x	CO.3.014	Service Fulfillment (Direct) Labor Cost		x	x	x	
CO.3.015	Production Automation Cost			x	CO.3.015	Service Fulfillment Automation Cost		x			
CO.3.016	Production Property, Plant and Equipment Cost			x	CO.3.016	Service Fulfillment Property, Plant and Equip…	x				
CO.3.017	Production GRC, Inventory and Overhead Cost			x	CO.3.017	Service Fulfillment GRC, Inventory and Overhead…	x				
CO.2.005	Order Management Cost				CO.2.005	Order Management Cost		x	x		
CO.3.018	Order Management Labor Cost				CO.3.018	Order Management Labor Cost		x			
CO.3.019	Order Management Automation Cost				CO.3.019	Order Management Automation Cost	x				
CO.3.020	Order Management Property, Plant and Equip…				CO.3.020	Order Management Property, Plant and Equip…	x				
CO.3.021	Order Management GRC and Overhead Cost				CO.3.021	Order Management GRC and Overhead Cost	x				
CO.2.006	Fulfillment Cost		x		CO.2.006						
CO.3.022	Transportation Cost		x		CO.3.022						
CO.3.023	Fulfillment Customs, Duties, Taxes and Tariffs Cost		x		CO.3.023						
CO.3.024	Fulfillment Labor Cost		x		CO.3.024						
CO.3.025	Fulfillment Automation Cost		x		CO.3.025						
CO.3.026	Fulfillment Property, Plant and Equipment Cost		x		CO.3.026						
CO.3.027	Fulfillment GRC, Inventory and Overhead Cost		x		CO.3.027						
CO.2.007	Returns Cost				CO.2.007	Returns Cost		x	x		
CO.3.028	Discounts and Refunds Cost	x			CO.3.028						
CO.3.029	Disposition Cost	x			CO.3.029						
CO.3.030	Return GRC, Inventory and Overhead Cost				CO.3.030	Return GRC, Inventory and Overhead Cost		x	x		
CO.2.008	Cost of Goods Sold	x			CO.2.008						

4.4.3 Agility

For agility, the process of Request is added, although it is not derived from the original list of analysed processes; it is part of the overall Level 1 metrics. Processes related to agility as it relates to Return processes are removed. Return processes are included to handle services that are returned because they are defective (to some set of criteria or specification). The relevance of ensuring that these service Return processes create an agile service supply chain, is believed to be less relevant for services given that the Return processes themselves are debated in terms of relevance to services. Return metrics are thus excluded from the agility analysis.

On the downside of adaptability, the concept of unutilised capacity was highlighted more. In services, the challenge does not lie in stranded inventories but rather the unutilised capacity. Therefore, the words “sustainable use” in the sentence are critical.

A number of Level 3 performance metrics were excluded in the Level 2 process elements. They were excluded as they provide mere definitions of the term being referenced. Upon investigation, equivalent definitions could be derived but the definitions become very situation specific and may be different across different services and contexts. Furthermore, this is in support of the view expressed in Chapter 3, that Level 3 processes and metrics tend to be industry-specific and need not be included as a generic model. Rather, they should be included where it assists the user of the model to derive their own metrics.

Agility Metrics linked to enabling processes were excluded, as the focus of the metrics is to provide sufficient context to use the model for a test group. In this, the enabling processes are regarded as elements required to create a complete model, but is not necessary to show the utility of the core SCOR model for standardised back-office processes.

Table 19 gives an overview of the analysis of the agility metrics, showing the exclusion of the Level 3 metrics. Most of the metrics are made appropriate through the use of semantics.

Table 19: Agility Metrics Analysis

Metric Reference	Metric Process Name	Metric Removed	Duplicate	Title Change	New Metric Reference	New Metric Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
AG.1.1	Upside Supply Chain Flexibility				AG.1.1	Upside Supply Chain Flexibility		x			
AG.2.1	Upside Source Flexibility			x	AG.2.1	Upside Request Flexibility		x			
AG.2.2	Upside Make Flexibility			x	AG.2.2	Upside Fulfil Flexibility		x			
AG.2.3	Upside Deliver Flexibility				AG.2.3	Upside Deliver Flexibility	x				
AG.2.4	Upside Source Return Flexibility	x									
AG.1.2	Upside Supply Chain Adaptability				AG.1.2	Upside Supply Chain Adaptability			x		
AG.2.6	Upside Source Adaptability			x	AG.2.6	Upside Request Adaptability		x			
AG.2.7	Upside Make Adaptability			x	AG.2.7	Upside Fulfil Adaptability		x			
AG.2.8	Upside Deliver Adaptability				AG.2.8	Upside Deliver Adaptability		x		x	
AG.1.3	Downside Supply Chain Adaptability				AG.1.3	Downside Supply Chain Adaptability			x		
AG.2.11	Downside Source Adaptability			x	AG.2.11	Downside Request Adaptability		x	x		
AG.2.12	Downside Make Adaptability			x	AG.2.12	Downside Fulfil Adaptability		x	x	x	
AG.2.13	Downside Deliver Adaptability				AG.2.13	Downside Deliver Adaptability		x	x		
AG.1.4	Overall Value At Risk				AG.1.4	Overall Value At Risk	x				
AG.3.1	% of labor used in logistics, not used in direct...	x									
AG.3.2	% of labor used in manufacturing, not used in...	x									
AG.3.3	Additional deliver return volume	x									
AG.3.4	Additional Delivery volume	x									
AG.3.9	Additional source volumes obtained in 30 days	x									
AG.3.31	Current Deliver Return Volume	x									
AG.3.32	Current Delivery Volume	x									
AG.3.38	Current Make Volume	x									
AG.3.40	Current Purchase Order Cycle Times	x									
AG.3.41	Current source return volume	x									
AG.3.42	Current Source Volume	x									
AG.3.44	Customer return order cycle time reestablished...	x									
AG.3.46	Demand sourcing-supplier constraints	x									

4.4.4 Asset Management

Table 20 provides an overview of the metrics analysed for Asset Management. As with Agility (discussed in section 4.4.3) the Level 3 elements relate more to definitions. They were excluded this case because they are very specific to stock-related metrics and less relevant to services.

Asset Management Metrics, linked to enabling processes, were excluded as the focus of the adapted service model was on the execution processes. The enabling processes are included to show the use of the model, but the metrics for these enabling processes are not included as it is not the major focus (as was discussed in Chapter 3).

Table 20: Asset Management Metric Analysis

Metric Reference	Metric Process Name	Metric Removed	Duplicate	Title Change	New Metric Reference	New Metric Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
AM1.1	Cash-to-Cash Cycle Time				AM1.1	Cash-to-Cash Cycle Time		x	x		
AM.2.3	Days Payable Outstanding				AM.2.3	Days Payable Outstanding	x				
AM.1.2	Return on Supply Chain Fixed Assets				AM.1.2	Return on Supply Chain Fixed Assets	x				
AM.1.3	Return on Working Capital				AM.1.3	Return on Working Capital	x				
AM.3.12	Deliver Return Cycle Time				AM.3.12	Deliver Return Cycle Time	x				
AM.3.16	Inventory Days of Supply - Raw Material	x									
AM.3.17	Inventory Days of Supply – WIP	x									
AM.3.21	Rebuild or recycle rate	x									
AM.3.22	Recyclable waste as % of total waste	x									
AM.3.28	Percentage Defective Inventory	x									
AM.3.45	Inventory Days of Supply - Finished Goods	x									

4.4.5 Reliability

Perfect Oder Fulfilment is included as a measure by nature of its status as a Level 1 metric in the SCOR model. The only other metric associated to the processes is that of Yield. A translation could be derived for this, but would be one purely to create a definition that would not be practical and would differ in the context of the service being studied. The measure is thus excluded to not include metrics that are included as purely academic.

Table 21 provides a summary of the analyses of the reliability metric.

Table 21: Reliability Metric Analysis

Metric Reference	Metric Process Name	Metric Removed	Duplicate	Title Change	New Metric Reference	New Metric Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
RL.1.1	Perfect Order Fulfillment				RL.1.1	Perfect Order Fulfillment		x			
RL.3.58	Yield	x									

4.4.6 Responsiveness

In terms of responsiveness, the deliver-cycle-time measure is greatly reduced by removing all the material handling steps to only include the customer acceptance stage of the process. Note, that earlier it was defined that the customer testing is part of the Fulfil process. It is relevant to keep a separate deliver cycle time as it clearly articulates the process of hand-over between various supply chain parties.

A number of Level 3 performance metrics were excluded from the Level 2 process elements. These Level 3 Metrics were excluded as they provide mere definitions of the term being referenced. Table 22 provides a summary of the responsiveness metrics.

Table 22: Responsiveness Metric Analysis

Metric Reference	Metric Process Name	Metric Removed	Duplicate	Title Change	New Metric Reference	New Metric Name	No Change	Semantic	Dropped Product Concepts	Added Services Concepts	New Description
RS.1.1	Order Fulfillment Cycle Time				RS.1.1	Order Fulfillment Cycle Time				x	
RS.2.1	Source Cycle Time			x	RS.2.1	Request Cycle Time		x			
RS.2.2	Make Cycle Time				RS.2.2	Fulfil Cycle Time		x			
RS.2.3	Deliver Cycle Time				RS.2.3	Deliver Cycle Time		x		x	
RS.3.19	Current customer return order cycle time	x									
RS.3.20	Current logistics order cycle time	x									
RS.3.21	Current manufacturing order cycle time	x									
RS.3.22	Current supplier return order cycle time	x									
RS.3.98	Plan Cycle Time	x									
RS.3.99	Plan Source Cycle Time	x									
RS.3.127	Source Return Cycle Time	x									

4.4.7 Summary of Performance Metrics Adaptation

The structures and definitions linked to the various performance metrics, which could be kept. Most of the changes relate to semantics. References to material handling and inventory are decreased, or in some cases removed, to decrease the focus and attention on inventory in the service supply chain.

4.5 Conclusion

This chapter has reviewed the application of the SCOR model to standardised back-office processes. Both process elements, as well as performance metrics, were considered. In general, the standard SCOR process elements (refer to Table 23), as well as performance metrics (refer to Table 24), were found to be relevant and applicable to standardised back-office services.

Changes made to the existing model were mostly on a semantic level. Decreasing or removing references to material handling and inventory made further changes.

Table 23: Summary of Process Changes

Total Number of Processes	204
Process Removed	50
Title Change	52
No Change	74
Semantic	64
Dropped Product Concepts	46
Added Services Concepts	13
New Description	3

Table 24: Summary of Metric Changes

Total Number of Metrics	89
Metric Removed	31
Duplicate	7
Title Change	22
No Change	17
Semantic	30
Dropped Product Concepts	16
Added Services Concepts	5
New Description	1

The chapter further discussed considerations from literature studies and previous research related to the applicability of the SCOR model to services. The approach to these observations was discussed and how it can be addressed in the reviewed model.

Additions to the existing model were limited, with the greatest addition being the further classification of the Make to Order concept - to an Unscheduled and Scheduled Fulfilment concept.

The outcome of deriving an adapted SCOR model, that is relevant to standardised back-office processes with minor modification (semantic or omission changes), supports the hypothesis that the concept of supply chain management is relevant to services. Specifically, that the SCOR model is relevant to these processes without being adapted to such an extent that it can no longer be considered to be in line with the original model.

The review of the process and performance elements further showed cases where the services might be less applicable if they are not standardised services. However, for a specific type of services the SCOR model and the processes are very relevant with the adaptations.

The next chapter will focus on the second part of the hypothesis related to this study: The creation of a model that can explain standardised services and shows that the SCOR model can explain services. Furthermore, consideration is required into the intuitive nature and the utility of such a model. It is arguable whether a model can be considered relevant if the intended users of the model do not easily understand the translated model. The following chapter will focus on the test of the model, using two facilitated walk-throughs with a test group to determine the utility of the adapted model.

Chapter 5
Case Study and Evaluation

The previous section discussed the adaptions made to the original SCOR model to develop the service SCOR model. The steps taken highlighted that an adapted SCOR model could be created by applying semantic changes, or through the use of omission (removing processes or descriptions that did not make sense). This was done in the context of applying the model to standardised back-office processes, as defined in section 2.2.1. The outcome supports the hypothesis that the SCOR model is applicable to standardised back-office services, as the model could be adapted with very little structural changes.

The foregoing sections have supported two of the three research questions of this study, namely:

1) How is supply chain management applicable to the services industry when considering a specific class of industrialised services?
2) How is the SCOR model applicable when considering a specific class of service and more specifically industrialised services?

Both of these questions are supported in the work of the previous chapters. The final research question that needs to be tested is:

3) Can a SCOR model be adapted to be useful in modelling a class of industrialised services?

Here, the primary question to be addressed is, "Would a model, that was created for standardised back-office services and is very similar to the original SCOR model, be considered useful?"

To test the usefulness of the model, a case study was created that described a typical standardised back-office service. This case study was applied to a set of middle-management participants in a series of workshops. Their feedback was gathered and analysed. This section will describe the creation of the case study, together with the outcomes of the workshops based on the case study.

The original case study of Weyers (1999) was created for earlier versions of the SCOR model - where there were four Level 1 process categories. The current SCOR model is classified into five categories. In the original case study, the reader is asked to prioritise the four categories in order of importance into one superior, one advantage and two parity dimensions. In the case of five categories, as contained in the adapted service SCOR model, the reader is asked to prioritise the categories into one superior, two advantage and two parity dimensions (refer to Figure 20).

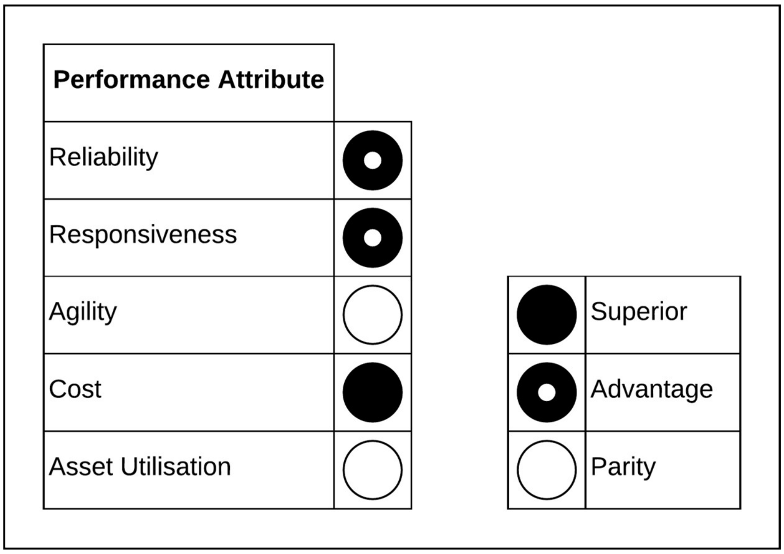

Figure 20: Performance Category Prioritisation

It is important to note that the test of the model is not to test the validity of the model. The adapted service SCOR is closely based on the original SCOR model. Based on the discussion in Chapter 4, the SCOR model is generally accepted in industry. It should thus follow that the model remains valid if it has not materially changed, despite service relevant semantic changes. The test of the case study is to establish the usability of the model in the context of services. In this case, reviewers that are professionals in a service industry, should test the model. Furthermore, it is assumed that the audience requires some guidance to structure their thinking around their supply chain and to aid in optimising their supply chain.

5.1 Creation of Case Study

A case study was adapted from a previous one created by Weyers (1999), which was used to illustrate the use of the SCOR model. The premise of the case study was that a reader could use it as a tutorial without any guidance. The case study could also be used as part of a facilitated course on discussing and teaching the use of the SCOR model. The case study was designed to be completed within eight hours as part of a facilitated course. The case study required that the delegates use the SCOR model while completing the case study.

The created/adapted case study is found in Appendix B. The following sections will give an overview of the facilitated walk-throughs that formed part of the case study that was created. The section will also elaborate on why the facilitated walk-throughs are regarded as standardised.

5.1.1 End User Support Case Study

The first facilitated walk-through is the process of supporting end-user devices, and is used to illustrate the workings of the model. The reader is then requested to apply the principles applied to the first facilitated walk-through to the second facilitated walk through.

The process of supporting the end-user IT devices is a service where desktop, laptop computers or mobile devices are maintained and supported. The service is traditionally initiated by a request from the customer. Although, it may also be a pro-active maintenance type function where a need to support the customer is driven by another event - suggesting that activity or work is required on the user's device.

Support for end-user devices is common practice but differs between the consumer and enterprise market. Consumers tend to support their own devices or take their devices to a computer retailer for assistance or repairs. In the enterprise business, enterprises take care of the support of the end-user devices themselves as a service to their employees. This may be done by the enterprise themselves or may be done by external vendors to various degrees. Various parties may be involved in the process, depending on the problem being experienced.

The service is part of a chain of services or service providers that together make-up the overall service to the customer. For this example, a customer initiating a call, referred to as an incident, triggers the end-user support supply chain. This goes through to a centralised helpdesk or pro-actively through an event, where maintenance teams detect the need for work to be done on the end-user's device (or requiring interaction with the end user).

Following this initiation of the incident, the helpdesk dealing with the call will at first try and resolve the incident. The helpdesk should be seen as a general function staffed by employees with a very general knowledge - but with the primary function being the capturing of the end-user incidents. Resolution is limited to highly structured events. From the helpdesk, the end-user's calls will be routed to a number of functions, depending on the specific content of the incident. For the purposes of this facilitated walk-through the focus is on the incidents related to support of the end-user device. Thus, only consider incidents related to this activity.

If the helpdesk is not able to resolve the incident, it is routed to a team of support engineers that will attempt to resolve the incident remotely - by taking control of the customer's device or guiding the customer to resolve the incident themselves.

If the incident cannot be resolved remotely, a field engineer is dispatched to the customer for resolution of the incident. If the problem is found to be one related to the hardware manufacturer, the field engineer may further require that the hardware vendor associated to the device repair the device. These repairs are completed either at the premises of the end user or at the premises of the hardware vendor, depending on the agreement with the hardware vendor. Furthermore, descriptions of the specific facilitated walk-through are provided in Appendix B .

The next step is to establish if the process described in the facilitated walk-through of end user support can be regarded as standardised. Weyers and Louw (2017) propose a framework to establish a degree of service standardisation. The framework does not provide an absolute measure of standardisation but rather dimensions according to which a qualitative assessment can be conducted. The dimensions of standardisation, together with descriptions, are provided in Table 25.

Table 25: Dimensions of Service Standardisation (Weyers and Louw, 2017)

Dimension of Service Standardisation	Standard Service	Customised Service
Service Employee	The work can be learned via studying procedures and manuals The work can be learned by repetitive completion of the task	Work is completed via the skills and creativity of the person performing the service
Service Delivery	The service process is or can be codified The time taken to perform the task is highly predictable and optimised over time	Service processes vary for each execution Steps taken to complete the service depend on the various inputs to the system
Service Result	Contracts exist that describe the service output in more than quantitative measures	The outputs of the service is based on a subjective assessment The outputs of the service are based on qualitative measures
Inputs to the Service	The number of inputs can be clearly defined The variation of inputs are finite and discrete	Inputs may vary with an infinite number of variations in input

The following paragraphs will evaluate the end-user support scenario according to the dimensions provided in Table 25. It should be noted that the various items raised below might not be explained explicitly in the scenario description. In these cases the processes, as they are generally in industry, will be considered for the evaluation of the level of standardisation.

On the dimension of Service Employee, the service tends toward the highly standardised dimension. Work is codified in knowledge guides, training is structured and a large proportion of the tasks or scenarios are limited in variety - with a few cases that are not easily definable. Here, Weyers et al. (2017) remark that the fact that the majority (and not all) of the cases are described or structured for this to be considered as standardised.

On the dimension of Service Delivery, the scenario provides timelines linked to each stage of the process. This points towards a form of predictability in the task. Again, reference is made to codification of the work. The process of end-user support follows highly structured procedures as well as knowledge guides.

The Service Result remains constant - the repair of and end-user's device. The Inputs to the Service dimension may have many inputs but in analysing the different number of inputs it is generally found that the inputs to this process have a limited number of instances where there is great variation and a large number of instances that have a limited number of permutations. This is further supported, as cases can be described according to best practices and knowledge guides. A further increasing trend in the field of end-user support is the support - not through human interaction but rather through standardised self-help portals or tools - within this industry. This points to a further level of standardisation of the process.

Based on this assessment, the process of end-user support may be regarded as standardised. The process may further be regarded as a back-office process based on the interaction with the client being remote through a call centre, with most of the work being completed by centralised functions - rather than directly with the client.

5.1.2 Server Support Case Study

The second facilitated walk-through is that of IT server support. This is a service where the tasks are completed to ensure that the IT server operating system is available for customer applications to run on these servers.

The IT server support service is one typically required from enterprises with large server farms, where the availability of their IT servers is critical for the operation of the business. The IT server support service is one that is contracted in advance, with an inventory of IT servers to be supported. This may be done by the enterprise themselves or by external vendors to various degrees. Various parties may be involved in the process, depending on the problem being experienced.

The service is part of a chain of services or service providers that together make up the overall service to the customer. For this example, the IT server support supply chain is triggered by an automated event, which is generated after a threshold condition has been experienced by one of the servers being supported. Ensuring that the IT server is enabled to allow these automated events triggers this event. This event is converted to a formal ticket, referred to as an incident, or a team of operators reviewing events may detect it.

The operator team will then investigate the incident further and confirm the validity of the incident. If the incident is found to be valid, the operator team will refer to the server support contract to establish if the server support contract has any special arrangements associated with the time to respond to the incident, or the time within which the server may be worked on. The operator team will establish the priority of the server event by reviewing the server contract information.

From here, the operator team will route the incident to the second level support teams. The second level support teams are made aware of the incident that has been created based, on the priority of the incident that was generated by the operator team.

The second level team will take the incident and resolve the incident as far as possible. The team can function across clients and across technologies; they may use automation toolsets to perform certain standardised functions and activities.

If the second level team are not able to resolve the problem, or where the criticality of the IT server requires special attention, the level three team may be required to assist in restoring the availability of the IT server.

The second or third level teams may also find that the problem lies beyond IT server support. An example of this may be that the ticket may require attention by a team of experts, focusing on server virtualisation technologies. From here, it may also be found that the physical IT server may have problems in which case the server hardware provider is called in to assist.

In assessing the level of standardisation, the service is evaluated according to Table 25. For the dimension of Service Employee, they are firstly being trained in the field and then through learning and observing the most common cases. There are highly specialised tasks that are not predictable, but the Level 3 engineers, as described in the facilitated walk-throughs handle these tasks. In the facilitated walk-through, it can be seen that very few tasks are eventually handed over toward the level three teams, in comparison to earlier parts of the chain. The majority of tasks are completed within the highly standardised areas.

For the area of Service Delivery, the service can be described as, standardised based on the need for guidelines and best practices. This is supported by the high dependency on governance and conformance. The processes that relate to server support must conform to audit requirement, due to the critical nature of IT services and the focus on IT security. These requirements further point to the level of standardisation. The Service Delivery is standardised; given that timelines are associated to the various tasks in the process. A further indicator of the level of standardisation is the industry trend toward greater automation of processes, within server support. The automation follows highly standardised activities - further supporting the view that the process is standardised.

For Service Result, the result is a service that is restored to a working condition and meets the service level requirements. Thus, there is very little variation in the output of the process. For Inputs to the Service, the number of inputs may vary greatly. In the facilitated walk-through, the majority of the inputs are handled through the structured area of the service delivery. Accordingly, much less cases handled by the Level 3 engineers that typically handle unstructured cases. From this, one could conclude that the inputs are more structured. There is also a growing trend in server support toward self-help, where the end consumers administer their own processes through highly standardised options. This is driven through the rapid growth of the concept of cloud computing.

The process of server support can be considered standardised. It should be noted that the process might not be as standardised as with the first facilitated walk-through of end-user support. It is possible that the service of server support is one that is currently undergoing a shift, from customised to standardised service. The service is a back-office service as it is completed indirect from the contact with the customer.

This section focused on the description of the facilitated walk-throughs and why they may be considered standardised. The following section will consider changes that had to be made with the overall case study, in order to accommodate the different nature of service - to the nature of manufacturing in applying the SCOR model.

5.2 Differences from Service case studies to Manufacturing case studies

The previous section described two scenarios used for service supply chains. The facilitated walk-throughs were created for service use cases that would fit the criteria of standardised back-office services. Additionally, there were a number of changes required in the structure of the overall case study. This section will not discuss the changes made to the original case study from a content perspective. The content and supply chains being considered are different because the original model focused on manufacturing and the adapted case study focuses on services. This section describes the changes that were required on a structural level in the creation of the case study, due to the change from product to service.

The most prominent difference is that in modelling the supply chain for manufacturing companies, there is a large focus on the location and logistic considerations. The first step in the case study approach proposed by Weyers (1999) was to draw a map with all the physical locations of the various actors in the supply chain. This step creates a context for the reader of the case study - to relate to the supply chain before abstracting the supply chain to the SCOR process elements. To address this setting of context, the reader started the case study by drawing a pictorial diagram of the various actors in the supply chain and then adding flows to the case study. Notations were added to each step, describing the supply chain in the adapted service SCOR model notation (refer to Appendix A).

A difference, flowing from the pictorial diagram, was describing the logic of flow that is less clear when moving from the original SCOR model to the adapted service SCOR model. The SCOR model requires a process flow diagram consisting of Source, Make and Deliver which moves from the most original supplier on the left, to the final customer on the right. This is the forward flow of the product.

For services, this flow may be confusing based on the nature of services and the role of the customer. The flow of information is from the customer up the chain (right to left), while the flow of the service-adding value is back from left to right. The direction of the arrows is thus from left to right as value is added. To assist the reader of the case study in bridging this logic, the user added the model notation from the very last role-player all the way to the first. This flow from the case study is shown in Figure 21.

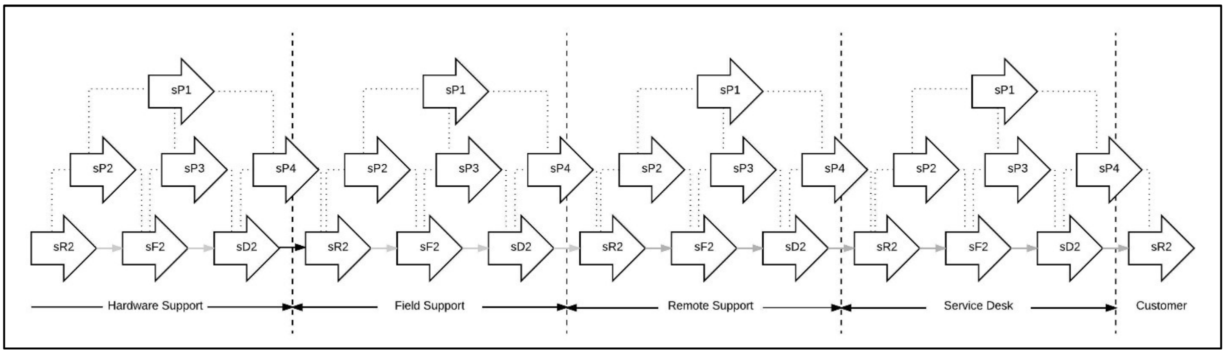

Figure 21: Case Study Process Flow Diagram

Although this logic of flow of information up the chain and value flowing down is easier to understand for a physical product. The challenge of flow of information vs. that of a product is not unique to a service. In a Make to Stock supply chain, the flow is from left to right. For Make to Order, the chain is triggered through a customer order. In this case, the supply chain of a physical product acts very similar to that of a service -the biggest difference between a service and a product is the tangible nature of a product.

A further difference from the nature of flow is that in the case of the services, not all the actors of the supply chain may participate. In the case of the services studied, the flow of information could be fulfilled by any of the actors moving up the chain. All actors downward from the chain would then be involved. This is similar to a Make to Order process. If any of the role-players in the supply chain had stock to fulfil the order as the information flowed up the supply chain, that actor would fulfil the item, without information flow up to the very first role-player. Although, the very first role-player would be involved in a Make to Stock scenario, for which there is no analogous concept in services.

The case study addressed these differences in the nature of services, by explaining them explicitly. Steps, guidelines and modelling rules would assist in the modelling process. For example, first just give step-by-step instructions as a modelling methodology and then it becomes more natural when analysing the chain later.

The original case study structure, described by Weyers (1999), was changed by adding a section on the cascading of performance metrics horizontally across the change. A section was inserted that explains the process of cascading metrics over the entire supply chain to the various individual companies in the supply chain (refer to Figure 22).

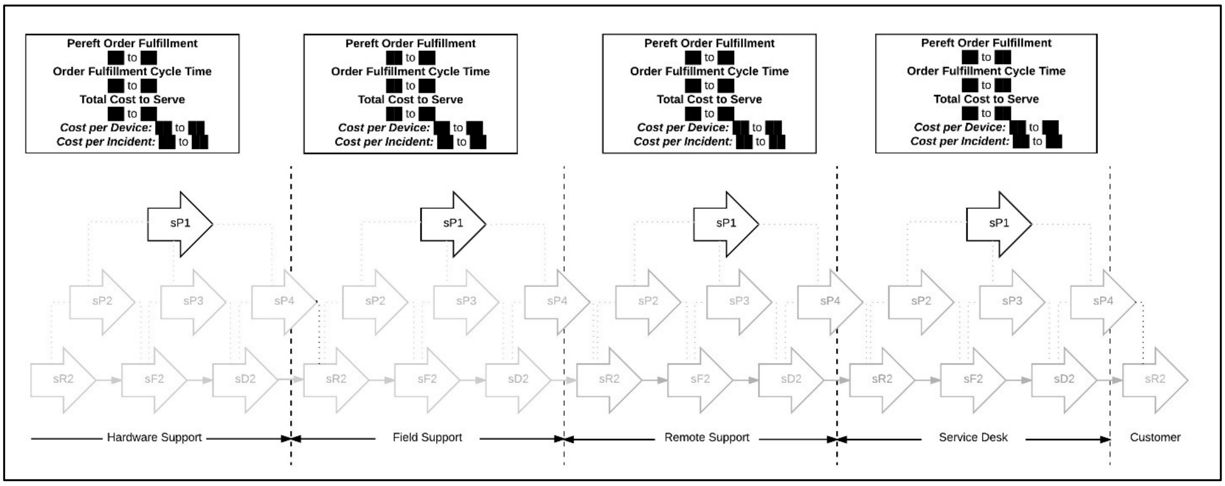

Figure 22: Horizontal Cascading of Measures

The case study then described the cascading of measures within the company vertically (refer to Figure 23).

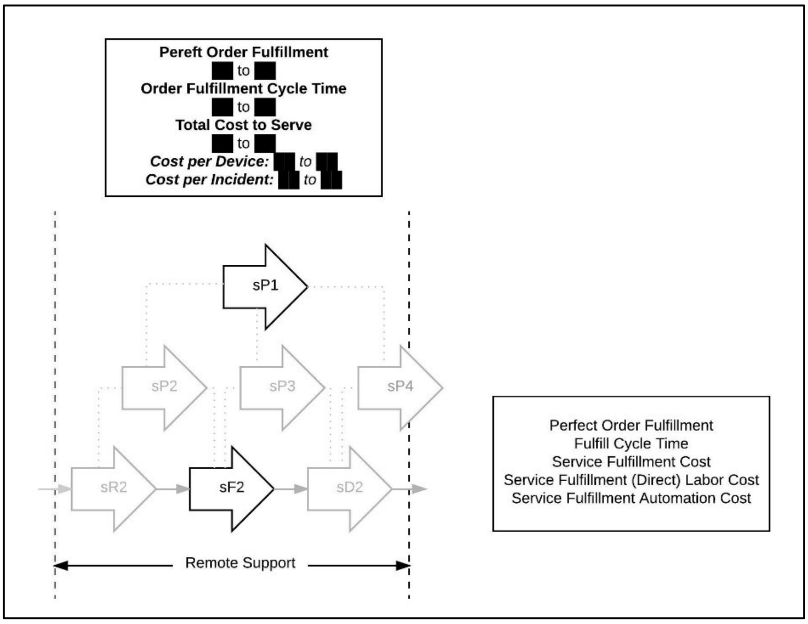

Figure 23: Vertical Cascading of Measures

This section described the structural changes to the case study, as opposed to a case study that is focused on explaining the SCOR model for manufacturing companies. There were additions to the structure of the case study to test specific dimensions of the model - as part of the objective of testing the usability and usefulness of the adapted service SCOR. The following section will discuss how the case study tested for the objectives of the model.

5.3 Structure of the case study to Test Objectives

The objective of the case study was to present the newly created, adapted service SCOR model in terms of its usefulness. The previous section already discussed structural changes that had to be made, due to the difference between service and product supply chains.

This section will discuss additions or changes made to the case study to ensure the testing of the model's usefulness. The major change in testing the usefulness of the model was to change the content of the use cases, in order to fit the type of service that was being analysed, namely a standardised back-office service. This would support the primary objective of performing the case study, which is to model a service using the adapted service SCOR model.

The overall model was positioned to the participants through the case study. There were elements that needed to be tested in further detail, examples of such a detailed explanation were the concepts of Request and Deliver. These elements are easily understood in manufacturing, but are not as easily understood within services. A separate section was included in the case study to discuss this dimension.

The dimension on the use of the Return element was not explicitly included in the document but would be covered as a discussion element. Similarly, the application to other services was also not explicitly included in the case study but would be included as a discussion item.

As part of the case study, the reader is invited to consult the adapted service SCOR glossary by considering the process elements as well as the performance metrics. The aim was for the reader to engage the definitions of the processes as well as the formulas of the calculations.

The structure of the case study was further adjusted to include a section discussing a process element in detail, to highlight the use of the Level 3 processes and descriptions. This was done as part of the discussion into the Request and Deliver processes but also as a separate discussion chapter on the human resources Enable process sE4.

The structure of the case study also explains the difference between Scheduled and Unscheduled services. This shows the use of the various process elements in the model, as the model must have different types of processes and the participants in the session must understand it. The various elements may not be used in the specific case study but during a guided training session, this point in the case study also encourages participants to think of other areas in their business where the concept of Scheduled and Unscheduled services may be relevant. There is a point in the case study where the general group has the opportunity to debate where the concept of Scheduled and Unscheduled services is relevant outside of the participant's specialised services.

The original SCOR model is a very mature model and has had multiple practitioners refining and adding to it over years. This is in contrast to the adapted service SCOR model, which has been created by deduction and reduction techniques from the original model. The result is that the performance metrics of the adapted service SCOR model are not as comprehensive as a full SCOR model. The case study addresses this by inviting the reader to use the existing measures as a basis to consider new measures. As an example, in the case study the concept of a Total Cost to Serve (CO.1.1) is used to explain that this may be expressed as the overall cost, this may also be expressed on a per device basis, or on a per event basis (as relevant to the case study). This introduces the concept of creating one's own measures. This is further emphasised as part of cascading the performance metrics vertically in the case study.

This section has discussed considerations in the creation of the case study that would allow the reader to be exposed to certain dimensions of the model, in order to test the model's usefulness. The relevance of the content of the case study must be seen separately from the relevance of the adapted service SCOR model. Both are important, but the test for utility is in the model. As such, the case study must expose the reader to these dimensions of the model and ensure there is enough exposure to make a judgement on its usefulness. In creating the contents of the case study, there are also observations of the applicability of the model to the case study; the following section will describe this applicability.

5.4 Observations in Preparing the Case Study

The objective of the case study was to test the relevance of the adapted service SCOR model to standardised back-office services. The creating of the case study and the content itself has been ignored up until now. It is also useful to consider the fit of the content to the model in preparing the case study.

The adapted service SCOR model has been developed for standardised back-office services. Two services illustrated the use of the model namely, the processes of supporting end-user devices and the service of Information technology (IT) server support. These services are increasingly becoming standardised, making them ideally suited to test in the adapted service SCOR model.

In applying the model to the two chosen service supply chains, the modelling constructs could sufficiently describe the two supply chains. Thus, the conclusion that the model was very relevant in modelling, analysing and improving the service supply chains. A test with a panel of experts would further confirm this conclusion reached during the creation of the case study. The use of a pictorial structure to create context to the diagrams and then translating this to the process elements were easy to perform, and after clarifying the complexity of distinguishing the flow of information from the flow of value, the chain could easily be modelled.

The standard model for the overall supply chain value (the Level 1 performance metrics) were all very relevant to the service supply chains being considered. Concepts like the supply chain flexibility were not normally considered relevant to the service chains being considered, but from an industry perspective, this measure has become more relevant to the service supply chains being evaluated as the industry for these services have matured. The model thus created a useful approach to structuring the modelling of the two service supply chain scenarios and a relevant structure in analysing and improving the supply chains. Experts would further support this through a review.

The adapted service SCOR model was thus very applicable to the two modelled service chains and described them very well. The model is generic in nature but the concepts contained in the model made it very relevant to the two service supply chains. Furthermore, it allowed for an overall structure within which the customisation to the two supply chains, in the form of more refined performance measures, is encouraged.

This section considered observations of the suitability of the adapted service SCOR model for the two scenarios of standardised back-office services, through the author applying the model to two service supply chains that illustrates the use of the model. The following section will expand on the facilitated walk-through of the service supply chains with participants, the observations and learning from these facilitated walk-throughs.

5.5 Facilitated Walk Through of the Model

The previous sections highlighted the creating of the case study, and its intention to test the usefulness of various dimensions of the model. The case study allows readers to study the model individually. The case study could also be used as course material in a facilitated walk-through. The method of a facilitated walk-through was used to observe participants interacting and using the model.

The facilitated walk-through was conducted by offering a class to invited participants, with the intention of analysing and optimising their service supply chain. This was performed through a series of workshops. The following sub-sections describe observations from each of the facilitated sessions.

5.5.1 Facilitated Workshop Round 1

Sixteen participants attended for the first workshop. The level of the participants was junior to middle management. The participants were chosen from functional areas in the services supply chains that were very similar to the two scenarios provided and were evenly representative of the various parties across the entire service supply chain.

The focus group was set up for the sixteen participants to sit in groups of four across four tables. The process of the facilitated walk-through was to step through a presentation aligned with the case study document. All participants were given a copy of the case study and a copy of the adapted service SCOR (Refer to Appendices A and B). The structure was to work through a chapter within the case study describing a specific dimension. Participants then discussed the second case study for the specific step in their groups. Each group then had to present their interpretation of the model to the rest of the participants. This allowed for discussion of their specific interpretation of their supply chains while using the model as the structure.

The focus group was originally intended to run between six and eight hours. The group could only allow for four hours, given the practicality that they are all responsible for managing critical areas in an IT Organisation. To accommodate the shortened timeframe, supporting material showed the calculations for the various steps extracted from the main case study document in the form of handouts for easier reference to speed up the review process. Participants were not asked to perform calculations on all the supply chain measures but only selected measures that would aid the most in understanding the measures. It was not the purpose of the evaluation of the usability to test the actual calculations of the adapted service SCOR model. The process of going through the calculations is also the most time-consuming element of the process. The approach of scaling down on these elements could be completed without compromising the validity of the model.

During the session, discussions were had in line with the intent of the model. When facilitating a discussion on the Scheduled vs. Unscheduled nature of services, the participants could successfully relate to services concepts within their own industry, as well as services outside of their industry. They could comprehend how the two types of services differ in nature.

Participants were guided through a process of understanding of the use of the Request and Deliver elements. This was done to expose them to the elements, even though the case study itself did not require the use of these elements to be evaluated for its usefulness. During the session, the participants had questions on some of the notations used in the examples. Thus, highlighting that the participants had been engaging the content and could identify when the example given did not match to the logic of the model that was explained. This related specifically to the use of the Request process as opposed to the Deliver process.

The participants themselves raised the concept of the Return process. This was discussed and easily understood in the context of services and could be related to their individual service supply chains.

The complexities of flow and the confusion of the flow of information from right to left (i.e. customer up the chain) while arrows are shown from left to right (i.e. as value is added), was raised as confusing. This was explained again and was generally understood (discussed in section 4.2.6).

Although the workings of the members were not collected, the teams had to present some of their workings on flip charts. The work on the individual workbooks was also viewed through observation of the participants. The participants were able to draw and map the processes and measures throughout the supply chain.

5.5.2 Facilitated Workshop Round 2

The second group comprised out of seven participants. The level of the participants was middle to senior management. The roles of the participants, related to the modelled supply chains, are as designers or architects of the processes of the services being performed. The focus of the participants was different to participants in the supply chains. The members of this group were required to design and analyse the end-to-end supply chains.

The focus group was set up for the seven participants to sit as one combined group. The remainder of the approach to the facilitated walk-through was the same as the first round.

As with the first group, the concept of the flow in one direction confused the participants. The flow is in two directions, firstly information flows up the chain and then the value flows back down toward the customer. However, the arrows in the model are only in one direction toward the final customer. This was understood after being explained again but was highlighted not to be intuitive.

The participants further highlighted that the flow of the services is in fact much more complex than single chains. Flow can move in multiple branches based on various decisions or conditions. This is not unique to services but may also be applicable in any supply chain modelled by SCOR. The logic of supply chain management, and SCOR, is to give the high-level overall flow to abstract the supply chain and to not be crowded with all the detailed flows that are applicable when looking at the individual process steps. The concept of "less" being preferred when taking a supply chain approach was discussed in section 3.5.2

The allocated time for the entire the walk-through was too short, as was mentioned in the first round. The observations around the concepts of Return, Request and Deliver, as well as the use of Unscheduled and Scheduled were similar to the first round.

The second round of the facilitated walk-through enforced the findings of the first round, even though the participants to the walk-through had a different perspective to the supply chain.

5.5.3 Facilitated Workshop Round 3

The third group consisted of twenty-four participants. The mixture of the group was middle managers involved in the activities of the supply chain, automation of the supply chain, designers of the supply chain and representatives from a procurement function. The list of participants included members from outside of the company.

The observations and flow of the session was very similar to the previous sessions discussed in paragraphs 5.5.1 and 5.5.2.

The structure of the originally created workshop was changed to accommodate less available time during the session than initially planned. Less focus was placed on the calculations of metrics and the workshop time was given five hours and not four hours, as with the previous two workshops.

5.5.4 Facilitated Workshop Round 4

The fourth group consisted of twenty-six participants. The mixture of the group was middle managers involved in the activities of the supply chain, automation of the supply chain, designers of the supply chain and representatives from a human resource function.

The observations and flow of the session was very similar to the previous sessions discussed in paragraphs 5.5.1, 5.5.2 and 5.5.3.

The workshop was changed to better accommodate for time - in line with workshop three. The workshop tried to better address the concept of the flow of processes. Greater emphasis was placed on debating supply chain optimisation, in line with the feedback received in the third workshop. Five hours were provided for discussion, in line with the approach in workshop three.

5.5.5 Summary

The previous paragraphs described the observations during the facilitated walk-throughs. Care was taken not to emphasize that the session was being used to evaluate the model. The objective was to test if the participants found the model useful. The usefulness of the model is apparent if the participants better understand their supply chain and have the ability to optimise it. The focus should thus not be on the technical merit of the model, but the use thereof. The participants were invited to participate in a case study that would illustrate to them a model that would help them in analysing their own supply chains. This approach allowed for the entire model to be described and participants could evaluate if the model would be useful to them.

The use of the various rounds allowed for a broad range of evaluations to be completed, with participants that have diverse perspectives on the studied supply chains.

The evaluation of the utility of the model was done through a questionnaire handed out at the end of the session. The following section will describe the consideration in creating the questions, followed by a section on the outcomes of the questionnaire.

5.6 Evaluation of Facilitated Case Study

The goal was to provide a questionnaire that could test the use of the model, but the questionnaire should not be seen as onerous to complete. The participants were all pressed for time in their normal operations, so it was important that the questionnaire be concise to receive accurate feedback. Gray (2004) mentions that the response rate to questionnaires runs the risk of being low if the questionnaire is too long. He suggests no more than four to six pages (Gray, 2004).

In keeping with the principle of simplifying the questionnaire, it was limited to one page. The page was less than the four to six pages, but the objective was to make the assessment easy to complete given that the participants already had limited time. The survey was kept short as participants were expected to complete the survey before leaving the room, to avoid problems with memory recall (discussed in the following paragraph). Using one page would take the participants an average of five minutes to complete considering that two open-ended questions were provided for.

Gray (2004) provides a list of considerations to avoid when constructing the questions. These are:

- Prejudicial language that may annoy, irritate or insult a respondent,
- Imprecision in the question that allows for vagueness,
- Leading questions,
- Double questions,
- Assumptive questions,
- Hypothetical questions,
- Knowledge ensuring that the group the question is asked to have knowledge of the question and
- Memory recalls as people easily forget events that happened recently.

To align to these principles, questions were kept simple and related to a specific core item that was being tested.

In the questionnaire for the first round, a limited number of free form questions were allowed, with a preference for structured responses. For structure, close-ended question responses were kept to a Yes / No response, referred to as a dichotomous question. In keeping with simplification of the questionnaire, consideration was given for deciding between Yes /No questions and scaled questions. Terre Blanche, Durrheim and Painter (2006) suggest that dichotomous questions should be used when obtaining factual information, whereas scaled questions should be used when evaluating the degree to which the respondent agrees with the statement. Questions were framed in such a nature that the respondent did not give an opinion, but rather answered with a factual statement. The question is their assessment and framed as an example: “Did the model improve your understanding of your business and how you fit into the overall service to the customer?” These questions could also have been framed to make it suitable for scaled answers but the dichotomous approach was chosen to improve the speed of the responses for the first round. This was changed in the second, third and fourth rounds where a four-point scale was used to gather the feedback from participants.

The question that would not suit the dichotomous style of questioning is where the participant is requested to give an opinion not relevant to their understanding. This is related to the application of the model to other services. The question would not have a high degree of use in any event, as the participants are not experts in all service industries, rather in the industry that they are working in. It was decided to keep the question, as it was something that may be interesting to assess.

Terre Blanche et al. (2006) suggest four steps in approaching the creation of a questionnaire. These steps are:

- Clarify the reason for the study,
- Determine the information he required from the respondents,
- List the research questions that are to be answered, and
- Identify additional demographics.

The case study consisted of fourteen structured questions and two free-form questions that would fit the design criteria given above (refer to Figure 24).

The questions started by asking the number of years that the participant had worked in the services industry. This was followed by a question asking if the participant had worked with a supply chain before, in any capacity.

Questions three to six were targeted at understanding whether the participant found the model useful in understanding their service, as well as giving guidance in analysing their service.

Questions seven to thirteen were directed at testing the understanding, as well as the use of various dimensions, of the model that may not seem as intuitive for services.

Question fourteen was to check whether the participant felt the model would be applicable to other service industries.

The above closed-ended questions would allow some feedback from the participants, testing their experience of the model in specific areas very directly and would allow participants to complete the assessment reasonably quickly. To allow for further insights from the participants, they were allowed to give two free-form comments that could be analysed.

Question fifteen asked for improvements on the model and was a free-text field. This was given to provide an area for general suggestions or improvements.

Question sixteen asked for the biggest learning from the participant and was again a free-text field. This was done to test benefits of using such a model as a structured approach to describing and analysing the supply chain.

None of the questions focused on the content of the case study. The content of the case study was verified as part of the overall facilitation process, by asking the participants if they thought their services were similar to the case study provided. However, this was not the objective of the facilitated case study. The facilitated case study was conducted to establish whether the participants found the model and its constructs useful. Thus, the questions were structured around these dimensions.

Questions six and thirteen are very similar. The difference lies in that question six is intended to understand whether the description gave an idea of what must be done. This is relevant as one area that makes the Level 3 process elements useful in the original SCOR model, is it provides guidelines on what must be done (even though detailed processes are still required for each element). Participants were tested to understand whether the steps were useful as highlighted when going through the model. Question thirteen is relevant as it tests the understanding of the descriptions.

The approach used in creating the adapted service SCOR was to keep to the structure and words of the original SCOR model as far as possible. Changes are preferably made through semantics or removing unnecessary steps. It should thus be checked whether the descriptions are then relevant and not too abstract or detached from the context of services. This is important in testing the usability of the model.

In the process of testing the validity, potential biases should be considered, together with mitigations to these biases. The following section will discuss these potential biases and how they were addressed.

5.6.1 Validity of the Questionnaire Responses

In analysing the responses received, all biases were avoided. A potential bias in the case study was that the presenter and researcher of the facilitated case study, were part of the organisation. Thus, care should be taken to ensure participants do not change their responses, based on their relationship to the facilitator.

Three actions were taken to mitigate this potential bias. The first step, was to make all responses anonymous; participants were asked to complete the questionnaire before leaving the course venue. Participants were asked to combine their responses at their tables and were handed in as a pack without the ability to associate the completed questionnaire to an individual thus, providing anonymity.

Furthermore, all responses from participants within two degrees of relationship with the facilitator, within the organisation structure, were discarded. This approach allows for the participants to not be directly associated to the facilitator and thus have less of a bias of being influenced by their relationship to the facilitator.

The final step taken to remove bias was that the participants were not made aware of the facilitator's relationship to the model. The model was presented as an industry model and as such, a model the presented by the facilitator with the view of assisting in their understanding of their respective services.

A further consideration in the entire process of the case study and the questionnaire is that the researcher is also involved in the services that were presented in the case study. This is not a valid concern, as the test was not the case study but rather the model. Furthermore, the model was not created with a specific industry in mind; the model was created as a generic model for standardised services. Lastly, the techniques used to create the model were also based on the knowledge of a specific case study or industry type. The model was created from the generic SCOR model and was adapted using concepts of the differences between services, manufacturing, and guidelines on SCOR model adaptation from other industries - and not through specific industry knowledge.

A further bias may be that the participants are all from the same industry, namely the IT industry. Both scenarios are from the IT industry but throughout the study it was shown that services in the IT industry have gone, and are undergoing, a transformation towards greater standardisation. To understand the generality of the model, participants were invited to consider other industries as the various concepts were introduced. The model itself was also not created with a certain industry in mind and not with principles derived from a specific industry.

Three questionnaires were discarded from the first group of sixteen participants, based on their degrees of separation from the facilitator, resulting in thirteen participant responses that could be considered for the first round. Feedback from thirteen participants, after interacting with the model for four hours for their services, is considered to be relevant to test the usability of the model. The short timeline given to understand the model has a hidden benefit that if a number of the participants are able to understand the model, it shows that it is reasonably easy to understand and has a level of intuitive fit to the standardised back-office services.

1	How many years have you worked in the services industry?		
2	Have you ever worked with supply-chain or used a supply-chain? (any capacity)	Yes	No
3	Did the model improve your understanding of your business and how you fit into the overall service to the customer?	Yes	No
4	Did the model help you in understanding how to analyse your business?	Yes	No
5	From your analysis, could you come up with ideas of how you could change the overall business?	Yes	No
6	Were the descriptions in the model accurate in what must be done?	Yes	No
7	Were the Level 1 performance metrics useful in giving ideas of what you should measure?	Yes	No
8	In looking at the HR process, did it give you an idea of what is expected of you in terms of the HR process?	Yes	No
9	Did the use of the REQUEST and DELIVER processes make sense in analysing the costs and time associated with these processes in your supply-chain	Yes	No
10	Was the model easy to understand and use?	Yes	No
11	Did the use of a Scheduled and Unscheduled services (e.g. sF1 or sF2) make sense?	Yes	No
12	Did you find the adapted service SCOR glossary with the process definitions useful?	Yes	No
13	Where the descriptions of the various process elements useful?	Yes	No
14	Do you think this model could be used for other services as well?	Yes	No
15	Do you have any suggestions or improvements to the model?		
16	What was the biggest learning for you personally?		

Figure 24: Questionnaire for Workshop Round 1

Based on the criteria of degrees of separation, questionnaires were discarded from the second, third and fourth round of questionnaires:

- Two questionnaires were discarded from the second group of seven participants, based on their degrees of separation from the facilitator resulting in five participant responses that could be considered for the second round.
- Three questionnaires were discarded from the third group of twenty-four participants, based on their degrees of separation from the facilitator resulting in twenty-one participant responses that could be considered for the third round.
- One questionnaire was discarded from the fourth group of twenty-two participants, based on their degrees of separation from the facilitator resulting in twenty-one participant responses that could be considered for the fourth round.

The questionnaire for the second group, and also the remaining groups, had changed to scaled responses as opposed to Yes / No responses (refer to Figure 25).

1	How many years have you worked in the services industry?				
		Not at all	Not much	Some what	Very
2	Have you ever worked with supply-chain or used a supply-chain? (any capacity)				
3	Did the model improve your understanding of your business and how you fit into the overall service to the customer?				
4	Did the model help you in understanding how to analyse your business?				
5	From your analysis, could you come up with ideas of how you could change the overall business?				
6	Were the descriptions in the model accurate in what must be done?				
7	Were the Level 1 performance metrics useful in giving ideas of what you should measure?				
8	In looking at the HR process, did it give you an idea of what is expected of you in terms of the HR process?				
9	Did the use of the REQUEST and DELIVER processes make sense in analysing the costs and time associated with these processes in your supply-chain				
10	Was the model easy to understand and use?				
11	Did the use of a Scheduled and Unscheduled services (e.g. sF1 or sF2) make sense?				
12	Did you find the adapted service SCOR glossary with the process definitions useful?				
13	Where the descriptions of the various process elements useful?				
14	Do you think this model could be used for other services as well?				
15	Do you have any suggestions or improvements to the model?				
16	What was the biggest learning for you personally?				

Figure 25: Questionnaire for Workshop Round 2, 3 and 4

The results from the questionnaire and the process of a facilitated walk-through of the case study are thus relevant in establishing the utility of the adapted service SCOR model.

5.6.2 Sample Size

As discussed, the new model was presented to seventy-two professionals that work in the field of standardised back-office services. The questionnaires were reduced to fifty-nine, by removing any questionnaires that could lead to possible bias. The question then becomes; how many questionnaires can be considered sufficient to test the usefulness of the model?

Dworkin (2012) finds that literature suggests the number of questionnaires required in a study to vary largely between 5 and 50. The variation in questionnaires depend on factors including:

4) The quality of data,
5) The scope of the study,
6) The nature of the topic,
7) The amount of useful information obtained from each participant,
8) The use of shadowed data
9) The qualitative method and study designed used, and
10) Saturating - filling, supporting, and providing repeated evidence for (Dworkin, 2012).

It should further be noted that the sample size used in qualitative research methods is often smaller than that used in quantitative research methods.

The questionnaire used in this study is one of a quantitative nature, with two final questions that can be regarded as qualitative. But it would be incorrect to view the questionnaire in isolation in this study. Participants are not only expected to complete a questionnaire; they are also asked to evaluate the model through a facilitated workshop of at least four hours and to evaluate the model thereafter. Thus, the nature of the evaluation in assessing the questionnaire should be regarded as in line with the principle of a qualitative nature, rather than a quantitative nature.

The concept of saturation is believed to be the most important factor to consider in evaluating the number of questionnaires used in the sample. As will be shown in section 5.7, there is little variation in the responses given. This observation applies even to the unstructured questions. Consequently, the conclusion is reached that the current number of questionnaires have reached a saturation level, and that no new significant observations will be received by conducting further workshops with evaluations of the workshops.

5.7 Outcomes of Questionnaire

This section will consider the responses received on the facilitated walk-through of the case study. The average years within the service industry of the participants was 15,46 years. Seven of the participants indicated that they had some form of exposure to supply-chain management.

5.7.1 Outcomes of Facilitated Workshop Round 1

Table 26 shows the outcome of the analysis of the Yes / No questions put to the participants in the first facilitated workshop.

Table 26: Questionnaire Analysis Round 1

1	How many years have you worked in the services industry?	15,46

		Yes	No
2	Have you ever worked with supply-chain or used a supply-chain? (any capacity)	6	7
3	Did the model improve your understanding of your business and how you fit into the overall service to the customer?	13	0
4	Did the model help you in understanding how to analyse your business?	13	0
5	From your analysis, could you come up with ideas of how you could change the overall business?	13	0
6	Were the descriptions in the model accurate in what must be done?	13	0
7	Were the Level 1 performance metrics useful in giving ideas of what you should measure?	13	0
8	In looking at the HR process, did it give you an idea of what is expected of you in terms of the HR process?	12	1
9	Did the use of the REQUEST and DELIVER processes make sense in analysing the costs and time associated with these processes in your supply-chain	13	0
10	Was the model easy to understand and use?	8	5
11	Did the use of a Scheduled and Unscheduled services (e.g. sF1 or sF2) make sense?	13	0
12	Did you find the adapted service SCOR glossary with the process definitions useful?	13	0
13	Where the descriptions of the various process elements useful?	13	0
14	Do you think this model could be used for other services as well?	13	0

Overall, most participants indicated that they had no interaction with the concept of Supply Chain Management before the specific session. This is understandable, given that the participants are experts in their specific service industry, and the concept of supply chain management is not often used in the context of services.

Of the specific areas tested, respondents were able to understand the concept. One respondent answered that they did not agree with what was expected in terms of the HR process. The area where most respondents did not support the learning from the facilitated walk-through was the easy understanding of the use of the model. It should be noted that the count of five "No" responses, three of these had in fact stated "Yes" with a comment written in the block related to the short time given. This was taken to then be a "No" as it may be that the participants answered "Yes" given the short time allowed to assimilate the model. When viewing the number of "Yes" responses for the understanding of the model, together with the "Yes" responses on very specific dimensions of the model, one can generally conclude that the participants did understand the model and found the model useful in understanding their supply chain.

All respondents said that the model was applicable to other services; this is an opinion, as the participants are not experts in other service industries but rather in their own specific service industry.

On the open-questions, the responses of the participants were classified based on general categories. Table 27 shows the outcomes to the open-ended question: "Do you have any suggestions or improvements to the model?"

Table 27: Improvement and Suggestion Feedback Round 1

Needed more time to work through the model	3
Discussion on how to implement the outcomes of the model is required	3

The feedback from the participants shows that a number of the participants did feel that more time should be allowed for the discussion of the model. Participants also commented on discussions on the implementation of the model. Although the SCOR model does not deal with the implementation directly, this is also an indication that the model is useful. The respondent would not be considering the steps to implementation if the outcome of their analysis did not point to changes that are required in their supply chain, based on their analysis. This supports the overall view that the participants regarded the adapted service SCOR model as useful.

Table 28 shows the outcomes to the open-ended question: "What was the biggest learning for you personally?"

Table 28: Personal Learning Feedback Round 1

The model helped in the understanding the strategy linked to the service	5
The model helped in understanding finances, cost and pricing of the service	7
The model helped understand the end to end service supply chain	7

The feedback shows that many of the participants commented on their personal understanding around the dimensions of strategy, finance or the end-to-end supply chain. This is in support of the usability of the model. One of the objectives of the generic SCOR model is to assist in modelling the supply chain to support analysis and improvements. The feedback from the participants support the objectives of modelling and analysing a supply chain, and supports the view that the adapted service SCOR model is useful in describing standardised back-office services. The feedback is also in line with the overall objectives expressed in literature for considering service supply chain management, as described in section 2.1.4.

5.7.2 Outcomes of Facilitated Workshop Round 2

Table 29 shows the outcome of the analysis of the questions put to the participants in the second facilitated workshop.

Table 29: Questionnaire Analysis Round 2

1	How many years have you worked in the services industry?	27,20			
		Not at all	Not much	Some what	Very
2	Have you ever worked with supply-chain or used a supply-chain? (any capacity)	1	2	2	0
3	Did the model improve your understanding of your business and how you fit into the overall service to the customer?	0	0	1	4
4	Did the model help you in understanding how to analyse your business?	0	0	2	3
5	From your analysis, could you come up with ideas of how you could change the overall business?	0	0	3	2
6	Were the descriptions in the model accurate in what must be done?	0	0	1	4
7	Were the Level 1 performance metrics useful in giving ideas of what you should measure?	0	0	4	1
8	In looking at the HR process, did it give you an idea of what is expected of you in terms of the HR process?	0	0	3	2
9	Did the use of the REQUEST and DELIVER processes make sense in analysing the costs and time associated with these processes in your supply-chain	0	0	1	4
10	Was the model easy to understand and use?	0	0	3	2
11	Did the use of a Scheduled and Unscheduled services (e.g. sF1 or sF2) make sense?	0	0	1	4
12	Did you find the adapted service SCOR glossary with the process definitions useful?	0	0	1	4
13	Where the descriptions of the various process elements useful?	0	0	2	3
14	Do you think this model could be used for other services as well?	0	0	0	5

As with the analysis of the first round of the facilitated workshop, the participants were mixed on prior experience of working in a supply chain. On the individual questions, the responses show overall support for the model constructs.

As with the first round, the short time should be considered in reference to the understanding. It may be useful to consider where participants overwhelmingly chose a specific score (i.e. four participants or more chose the same rating). On the item of the Level 1 metrics, giving ideas of what should be measured further, four of the five participants rated this “Somewhat”. This could simply be because of the time constraints but specific focus could be given in the case study to highlight the additional measures that can be bettered. However, this may not be as much a function of the overall model.

The remainder of the responses range between being divided between “Somewhat” and “Very”, with a preference towards the “Very” rating. This rating provides insight into the first round of evaluations and supports the findings of the first round.

On the free-form questions, there were very few responses. The most notable trend is that two of the comments pointed to the participants getting a much better understanding of the supply chains they have been working in. Additionally, the approach of using supply chain management had put structure to tasks that they had been performing intuitively. This is again in line with objectives of performing supply chain management.

5.7.3 Outcomes of Facilitated Workshop Round 3

Table 30 shows the outcomes of the analysis of the questions put to the participants in the third facilitated workshop.

Table 30: Questionnaire Analysis Round 3

1	How many years have you worked in the services industry?	21,41			
		Not at all	Not much	Some what	Very
2	Have you ever worked with supply-chain or used a supply-chain? (any capacity)	3	3	6	9
3	Did the model improve your understanding of your business and how you fit into the overall service to the customer?	0	1	9	11
4	Did the model help you in understanding how to analyse your business?	0	1	12	8
5	From your analysis, could you come up with ideas of how you could change the overall business?	0	4	11	6
6	Were the descriptions in the model accurate in what must be done?	0	0	8	13
7	Were the Level 1 performance metrics useful in giving ideas of what you should measure?	0	1	10	10
8	In looking at the HR process, did it give you an idea of what is expected of you in terms of the HR process?	1	3	9	8
9	Did the use of the REQUEST and DELIVER processes make sense in analysing the costs and time associated with these processes in your supply-chain	0	1	8	12
10	Was the model easy to understand and use?	0	1	11	9
11	Did the use of a Scheduled and Unscheduled services (e.g. sF1 or sF2) make sense?	0	0	8	13
12	Did you find the adapted service SCOR glossary with the process definitions useful?	0	1	12	8
13	Where the descriptions of the various process elements useful?	0	1	9	11
14	Do you think this model could be used for other services as well?	0	0	4	17

In contrast to previous rounds, more participants felt that the model did not assist in coming up with future ways of improving the supply chain. The model itself does not give suggestions on improving the supply chain, although, the model is used as a tool to facilitate this. The short timelines, as well as the larger group, may also explain this observation. Overall, the rating is still toward it being useful in this dimension.

The second area where more participants were critical of the model was around the use of the HR dimensions. As the HR dimensions are not a specific focus of the guided case study, but rather something simply added to the case study at the end to illustrate its use, less participants may have found this useful in the context of the overall supply chain modelling. As in the previous paragraph, the majority of the feedback still points to the process being useful.

Round three was a much larger group to the previous two groups with a much more diverse set of participants. The overall results point to the dimensions of the model being useful to the practitioners in a service supply chain.

5.7.4 Outcomes of Facilitated Workshop Round 4

Table 31 shows the outcomes of the analysis of the questions put to the participants in the fourth facilitated workshop.

Table 31: Questionnaire Analysis Round 4

1	How many years have you worked in the services industry?	17,42			
		Not at all	Not much	Some what	Very
2	Have you ever worked with supply-chain or used a supply-chain? (any capacity)	5	5	9	2
3	Did the model improve your understanding of your business and how you fit into the overall service to the customer?	0	0	5	16
4	Did the model help you in understanding how to analyse your business?	0	0	6	15
5	From your analysis, could you come up with ideas of how you could change the overall business?	0	0	14	7
6	Were the descriptions in the model accurate in what must be done?	0	0	5	16
7	Were the Level 1 performance metrics useful in giving ideas of what you should measure?	0	0	5	16
8	In looking at the HR process, did it give you an idea of what is expected of you in terms of the HR process?	0	0	10	11
9	Did the use of the REQUEST and DELIVER processes make sense in analysing the costs and time associated with these processes in your supply-chain	0	1	5	15
10	Was the model easy to understand and use?	0	0	9	12
11	Did the use of a Scheduled and Unscheduled services (e.g. sF1 or sF2) make sense?	0	0	7	14
12	Did you find the adapted service SCOR glossary with the process definitions useful?	0	0	7	14
13	Where the descriptions of the various process elements useful?	0	0	5	16
14	Do you think this model could be used for other services as well?	0	0	3	18

The results show an improved score in the model assisting in looking at ways to improve the future supply chain. Simply focusing the workshop, more on these dimensions achieved this. The model itself is not focused on creating a future supply chain. Rather, it is used to facilitate further discussions around the topic. This workshop and the approach highlighted this dimension further.

The overall results show a positive experience of the model in the context of its use in understanding the services supply chains modelled.

5.7.5 Summary

The outcomes of the various rounds of the facilitated workshops are aligned, and overall show that the model was found useful and that the various constructs tested were understood. Approaches were taken to remove potential bias in the questionnaires. The largest remaining bias is that the questionnaires were completed within a single company and that affinity to the researcher may have influenced the results. This was addressed by removing responses where the participants were within two degrees of separation from the researcher. Furthermore, various members in the organisation, tested the alignment from the discussion with the received results by conducting informal discussions following the workshops. The feedback from these informal discussions supported the questionnaire feedback. Thus, the questionnaire feedback can be considered a true reflection of the participants' views of the adapted model.

Sixty questionnaires were analysed with the majority of responses indicating the usefulness of the model.

5.8 Conclusion

This section considered the evaluation of the model for its usability. The validity of the model was not tested here, as the validity of the model lies in the approach taken to adapt the model from the original SCOR model through a structured transformation process.

The objective of this chapter was to test whether the adapted model would be useful within the service industry, as opposed to a theoretical model that would not be useful within services.

The validity of the model was enforced through the work in this section. The creation of two scenarios, the application of the model to the two scenarios and the level to which the model could describe the complexity of the case study, support the validity of the model.

To test the utility of the model, sixty participants attended a facilitated workshop of the two scenarios. Participants were asked to evaluate the model after completing the walk-through, using closed and open-ended questions. The outcome from both the closed and open-ended evaluation was that the participants could understand the various detailed elements of the model. The model further assisted the participants in understanding their supply chain better.

The largest requests were that the walk-through required more time and that it could include the steps to the implementation of the adapted service SCOR model. However, this dimension is beyond the scope of the model and is rather a reflection of what could be used to enhance the case study.

The outcome of this section thus answers the third question of the research problem: "Can a SCOR model be adapted to be useful in modelling a class of industrialised services?"

Chapter 6
Summary, Conclusions and Recommendations

This study set out to address three questions in creating a supply chain model for service:

1. How is supply chain management applicable to the services industry when considering a specific class of industrialised services?
2. How is the SCOR model applicable when considering a specific class of service and more specifically industrialised services?
3. Can a SCOR model be adapted to be useful in modelling a class of industrialised services?

The study took an approach of describing the services industry, specifically studying services in relation to manufacturing. The concept of supply chain management was studied and followed by a specific focus on the SCOR model and the adaptation of the SCOR model. Lastly, the study focused on the relevance or use of the model that is derived from the foregoing steps.

The nature of services as opposed to that of manufacturing was studied. It was shown in this study that the characteristics of services tended to be similar to those typically associated with manufacturing when considering industrialised services, satisfying the first research objective.

The SCOR model was adapted based on the nature of industrialised services and it was found that a model could be derived with little structural changes and mostly semantic changes satisfying the second research objective that the SCOR model is applicable in its current form to industrialised services.

The adapted model was lastly tested by experts in the services industry, dealing with industrialised services and found the model to be useful and relevant satisfying the third research objective.

This section will highlight the unique contribution of this study and the conclusions that can be drawn together with suggestions for further research.

6.1 Research Contribution

The unique contribution of this work is not only the resulting adapted service SCOR model. The unique contribution is also the process of creating an adapted SCOR model for services, through techniques that keep to the original SCOR model as far as possible. This is done for a specific type of services.

Other adaptations of the SCOR model and works that have adapted the SCOR specifically for services do exist. Two examples of these are the work of Giannakis (2011) and Barnard (2006).

Giannakis (2011) applied the SCOR model to consulting services. The study viewed the consulting as the factory; the service was thus one that may not have similar characteristics than that typically expected from manufacturing companies. The conclusion Giannakis (2011) comes to, is that the supply chain management concepts have to be adapted significantly to fit services. This is to be expected given the nature of service studied (this was discussed in Chapter 2). There is thus value in considering the models on different types of services.

Giannakis (2011) follows an approach very similar to what is proposed in this thesis in mapping the SCOR model for services up to Level 2. The difference in the research is that Giannakis (2011) focused on a consulting service and thus concluded that many of the constructs within the traditional SCOR model are not valid, rather required new constructs. This research differs in focusing on services that could be described to be closer to traditional manufacturing than the consulting services that Giannakis (2011) considered.

Barnard (2006) creates an adapted SCOR model, but applies it to a very specific industry (Health Care and Insurance). Barnard (2006) adapts the various SCOR constructs to fit the specific case study. Descriptions are attached to the various SCOR constructs, based on the knowledge of building the model. The study does not take time to explain the process taken to adapt the model.

The above studies must be seen with the generalisations that manufacturing practices should not be applied to services and that services are significantly different.

This study makes its contribution as it explains that the generalisation of services is too broad. As with manufacturing, services are not one homogenous concept. There are in fact various types of services with different types of characteristics. The study uses one classification of services in terms of standardisation and customer interaction (described in Chapter 2). This framework is then used to explain the different characteristics of the services. Finally, this framework is used to explain the differing opinions on the suitability of applying manufacturing techniques to services.

With the classification of services established, the concept of supply chain management is applied to the specific type of service. Techniques are defined for adapting the SCOR model. A further contribution is using the structured approach to adapting the SCOR model for services.

The approach taken in this study may be applied by practitioners adapting the SCOR model for their specific application but specifically for service sectors. In the application, the practitioner can then utilise the SCOR model concepts without having to create new concepts for services. The approach to using the SCOR model for specific types of services, more suited to the use of the model, enables practitioners to gain access to the mature supply chain models from manufacturing and apply them to services.

The output of the model may be unique, but the real unique contribution lies in the approach to classifying services. This approach includes: explaining the general assertions made regarding services and the applicability of manufacturing techniques to services specifically, then combining this classification with techniques to adapt the SCOR model in a structured approach. Thus, this approach ensures the integrity of the adapted service SCOR model.

6.2 Conclusion

This study has shown that services could be categorised and that they have different characteristics in their classification. It was shown that there are categories of services that exhibit behaviour similar to manufacturing. The most significant difference between services and manufacturing was shown to be the intangible nature of services. Some of the consequences of this intangible nature of services are further also relevant in a product-centric process. An example of this is the characteristic that services cannot be stored as inventory. This is similar to describing service to have a characteristic analogous to that of perishable products, which can also have little to no ability to be kept as inventory.

The largest consequence of the intangible nature of services is the inability to visualise the flow of inventory and thus conceptually apply techniques targeted at the flow of inventory. It is with this inability to visualise the flow of services that the technique of proxies to inventory is used, to bridge this conceptual difference between services and products. Furthermore, it is shown that the concepts of proxies to inventory are more applicable to a specific type of service that is similar to the characteristics of products.

The study shows the characteristics of supply chain management and the various approaches to modelling supply chain management in the context of services. This is done based on the various perspectives that can be taken to modelling the supply chain of services. The process-centric approach is taken for this study, as the aim is to show the end-to-end analysis and improvement of the supply chain, making the process-driven approach most suited. The SCOR model is chosen primarily based on its popularity in modelling supply chains in general.

Techniques are explored for adapting the SCOR model. The overall goal is to adapt the model while still upholding the integrity of the original. The goal of the study is not to build a new model in itself, but rather to show that manufacturing practices for supply chain management are applicable to services, or a specific category of services. Thus, the goal is to adapt and create model that still maintains the concepts and integrity of the SCOR model but is applicable to services.

An approach is taken to create an adapted SCOR model. The approach taken is to assess high-level structural changes, followed by a stepwise approach to adapting process elements and process descriptions for Levels one, two and three of the SCOR model. Performance metrics associated to process elements for Level 1 and Level 2 are also evaluated. On a structural level the concept of Make to Stock is removed. The concept of Make to Order is divided into greater granularity, in terms of Scheduled and Unscheduled services in line with the work of Barnard (2006).

The resultant SCOR model is a SCOR model adapted for services. It keeps the integrity of the original SCOR model and is in essence very similar to the original SCOR model but better suited to the standardised back-office services that are being studied.

The final objective of this study was that the model must be useful. It may be easy to create a model shown to be relevant to services. However, it may be a theoretical model requiring complex translation of constructs from manufacturing to services for it to make sense. It is for this reason that the test should not be for experts to give their opinion on the validity of the model. Experts in the field are expected to be well versed in the concepts and would easily be able to understand the translation from manufacturing concepts to services.

Creating a case study with exercises, tests the usefulness of the model. Participants who work with back-office services completed these exercises. The process of creating the case study, consisting of two use cases, is the first indication that the adapted service SCOR model is valid, as the model is able to describe the use cases sufficiently for analysis. The participants were asked if they were able to understand the various constructs of the adapted service SCOR model, based on their interaction with the case study. The outcome is that the participants were all able to understand the model and its constructs. The feedback further shows that the participants found the model useful in understanding the end-to-end supply chain, to analyse and improve their supply chain and also to understand the finances linked to their supply chain.

The study shows that a supply chain model could be created for standardised back-office services and that the created model was useful to participants that work with these services.

Supply chain management principles, and specific the use of the SCOR model, is useful when applying a model to standardised back-office services.

6.3 Future Research

The approach of this study was to work from the base assumption that supply chain management principles are not applicable to services. This is based on the general assumption that services are different to manufacturing and on the outcomes of attempts to create SCOR-based models for services such as that of Giannakis (2011). This study then investigated whether there is a specific type of service where the principles of supply chain management, and specifically SCOR, is applicable to services. The outcome is to show that there is a specific type of services that can be explained and modelled through an adapted SCOR model, while still maintaining the integrity of the original. The research does not investigate that services beyond standardised back-office services cannot be explained by an adapted SCOR model, and to what extent those services require adaptation in the SCOR model. Thus, there is a need for research if other categories of services could also be modelled using the SCOR model and the adaptations required of the SCOR model for the adapted model to be useful.

This study further used two IT processes as examples of standardised back-office processes, to illustrate and test the use of the model. The work also uses many observations of IT services in understanding the changing nature of services. This is done as IT services are currently transforming and are considered good examples of understanding the changing nature of services. Further research is required of the applicability of the adapted service SCOR model to other service industries that fit into the category of standardised back-office services.

The research approach was tested on practitioners of industrialised services. This was done to test the usefulness and applicability of the model, with an objective of the model aiding in understanding the analysis and improvement of the service supply chain. Although process experts and analysts were part of the group evaluating the model, these experts were not explicitly identified. Further research can be conducted to test the use of the model by process specialists in addition to the practitioners in the field. The use of the practitioners did provide insight into the use of the model for enabling better understanding of the supply chain. A general observation of the practitioners is the extent to which supply chain management assisted in breaking silo thinking that had been encouraged through the division of labour in the overall delivery of the industrialised service supply chain.

The final adapted model, together with the process taken to adapt the model, is not done in an industry-specific approach. The adapted service SCOR model is adapted from the generic model with no addition of any industry specific knowledge, other than a translation to the service concepts that were discussed in the literature research. The concept of the applicability of the research to other service industries was also tested during the case study and the participants all agreed it was suited to other industries. There is, however, little validity in this view as the participants were experts in the IT industry and not services from different sectors. The applicability of an adapted SCOR model to other standardised back-office services should be investigated, although the model at face value is relevant to other service industries.

The concept of standardised services is used within industry as well as this study. However, there is no definition of service standardisation or indications of what service standardisation, means. This is similar to manufacturing, where references are made to standardisation and generally used without relating to some form of framework or guidelines. It is a concept where readers and researchers simply refer to standardised services or manufacturing processes and products. Research should be conducted to further explore the concept of service standardisation, if not to a definition and measure of service standardisation, then a framework or dimensions of service standardisation.

Proxies to inventory are used to assist in modelling the supply chain of standardised back-office services. Little literature exists to describe the concept on its own. The concept of proxy to inventory is used intuitively as researchers model their supply chain. Examples of this is Giannakis (2011) that uses capacity as the proxy to inventory, or Maull et al. (2012) that use the customer as a proxy to inventory. Research into describing the concept of proxies to inventory in a more structured approach may be of use to researchers modelling service supply chains, rather than deriving these proxies to inventory intuitively.

The adapted service SCOR model introduces an element analogous to the Engineer to Order concept, through the concept of an Engineered Service. The process was never used within the case study or as part of a standardised back-office process but was added for completeness. There is arguably room for including this process element in a model where standardised back-office services are being modelled for requests that require some form of bespoke development, even though the majority of services are standardised. It may even be extended to be applicable to non-standardised industries like consulting. In this case, the model may be able to explain the process but it is possible that the value of modelling the service through this method is not useful. Research into the use of modelling services through the Engineered Service concept can be evaluated for its use, as well as its usefulness.

The Level 1 performance metrics were all applicable to services. One area that may require more attention is the financial measures of asset utilisation. The current measures are relevant to services. Nevertheless, an evaluation on financial measures of asset utilisation that are typically used within services, should be considered as they relate to the model for possible addition or exchange with existing measures.

This research has shown the applicability of supply chain management principles found in manufacturing to standardised back-office services, and specifically through the use of the SCOR model. The adapted service SCOR model is found to be useful by practitioners working with standardised back-office services.

Further research will serve to grow and refine the model and its use, to improve the services industry as the service industry transforms from a highly bespoke nature, to more standardised services.

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Appendix A
Adapted Service SCOR

A.1 sP1 Plan Supply Chain

The development and establishment of courses of action over specified time periods, which represent a projected appropriation of supply chain resources to meet supply chain requirements for the longest time fence constraints of supply resources.

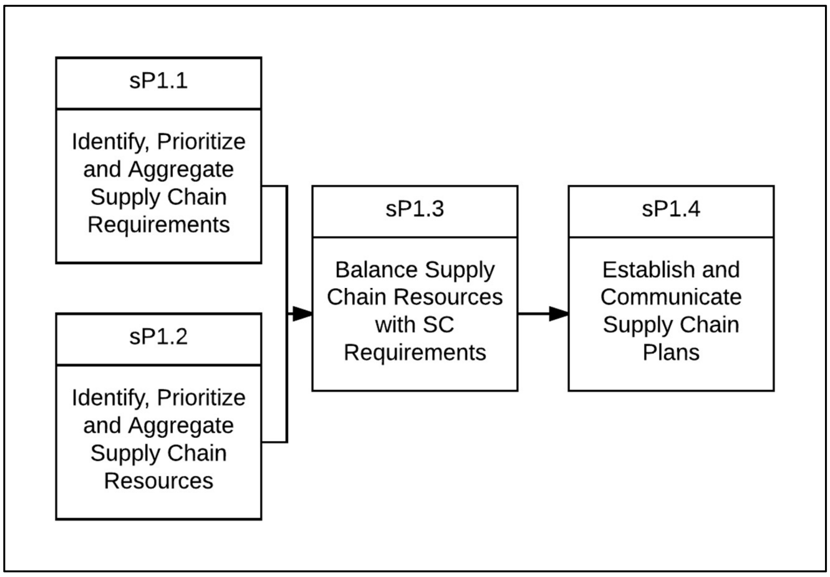

Figure 26: sP1 Plan Supply Chain

Hierarchy

sP1.1 Identify, Prioritize and Aggregate Supply Chain Requirements: The process of identifying, aggregating, and prioritizing, all sources of demand for the integrated supply chain of a service at the appropriate level, horizon and interval. The sales forecast is comprised of the following concepts: sales forecasting level, time horizon, and time interval. The sales forecasting level is the focal point in the corporate hierarchy where the forecast is needed at the most generic level. i.e. Corporate forecast, Divisional forecast, Product Line forecast, Service Portfolio Element. The sales forecasting time horizon generally coincides with the time frame of the plan for which it was developed i.e. Annual, 1-5 years, 1- 6 months, Daily, Weekly, Monthly. The sales forecasting time interval generally coincides with how often the plan is updated, i.e. Daily, Weekly, Monthly, and Quarterly.

sP1.2 Identify, Prioritize and Aggregate Supply Chain Resources: The process of identifying, prioritizing, and aggregating, as a whole with constituent service providers, all service providers are required and add value in the supply chain of a service at the appropriate level, horizon and interval.

sP1.3 Balance Supply Chain Resources with SC Requirements: The process of identifying and measuring the gaps and imbalances between demand and resources in order to determine how to best resolve the variances through shaping of the demand through marketing, delaying of existing demand through postponement processes, strategies of prioritising existing customers or orders. The process of developing a time-phased course of action, which commits supply-chain resources, to meet supply-chain requirements.

sP1.4 Establish and Communicate Supply Chain Plans: The establishment and communication of courses of action over the appropriate time-defined (long-term, annual, monthly, weekly) planning horizon and interval, representing a projected appropriation of supply-chain resources to meet supply chain requirements.

Metrics

RS.1.1 Order Fulfilment Cycle Time

CO.2.001 Planning Cost

CO.3.001 Planning Labour Cost

CO.3.002 Planning Automation Cost

CO.3.003 Planning Property, Plant and Equipment Cost

CO.3.004 Planning GRC and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.2 sP2 Plan Request

The development and establishment of courses of action over specified time periods that represent a projected appropriation of service related resources to meet supply chain requirements.

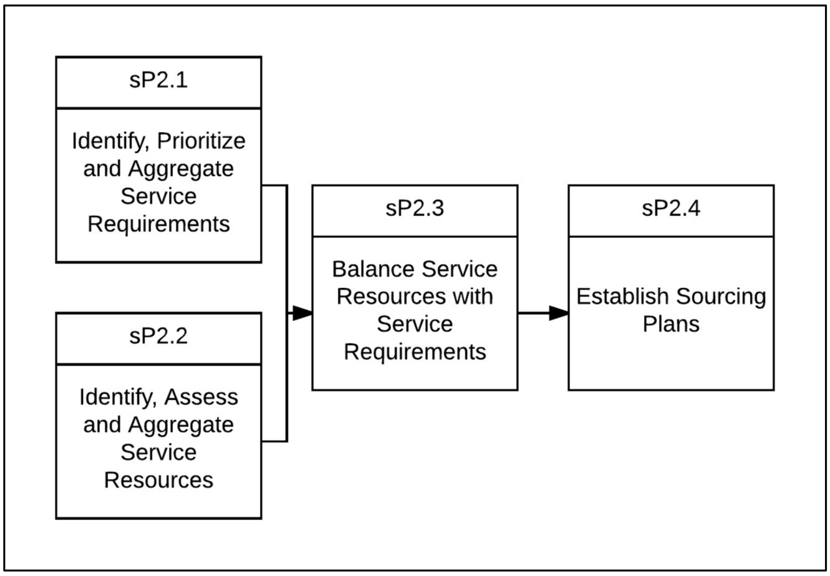

Figure 27: sP2 Plan Request

Hierarchy

sP2.1 Identify, Prioritize and Aggregate Service Requirements: The process of identifying, prioritizing, and considering, as a whole with constituent services, all sources of demand for a service in the supply chain.

sP2.2 Identify, Assess and Aggregate Service Resources: The process of identifying, evaluating, and considering, as a whole with constituent services, all resources used to add value in the supply chain for a services.

sP2.3 Balance Service Resources with Service Requirements: The process of developing a time-phased course of action that commits resources to meet requirements.

sP2.4 Establish Sourcing Plans: The establishment of courses of action over specified time periods that represent a projected appropriation of supply resources to meet sourcing plan requirements.

Metrics

RS.1.1 Order Fulfilment Cycle Time

CO.2.001 Planning Cost

CO.3.001 Planning Labour Cost

CO.3.002 Planning Automation Cost

CO.3.003 Planning Property, Plant and Equipment Cost

CO.3.004 Planning GRC and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.3 sP3 Plan Fulfil

The development and establishment of courses of action over specified time periods that represent a projected appropriation of service resources to meet production requirements.

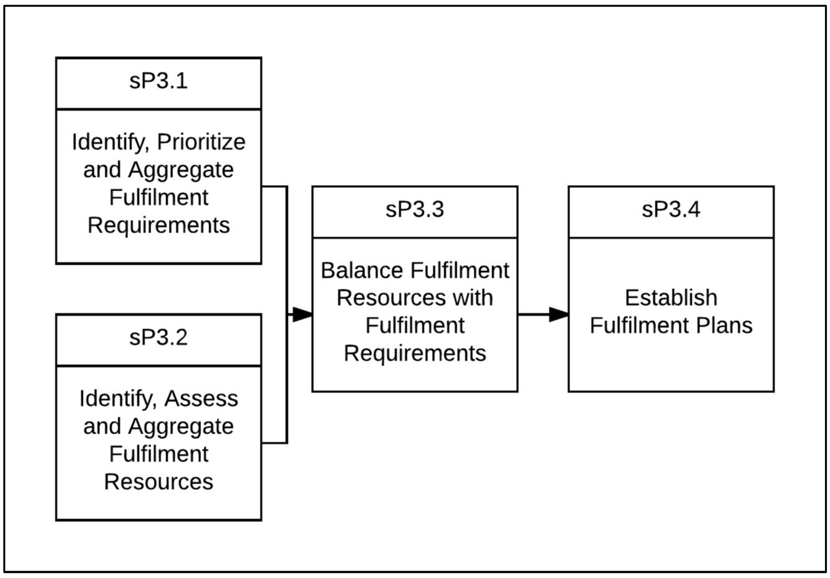

Figure 28: Plan Fulfil

Hierarchy

sP3.1 Identify, Prioritize and Aggregate Fulfilment Requirements: The process of identifying, prioritizing, and considering as a whole with constituent services, all sources of demand in the creation of a service.

sP3.2 Identify, Assess and Aggregate Fulfilment Resources: The process of identifying, evaluating, and considering, as a whole with constituent services, all things that add value in the creation of a performance of a service.

sP3.3 Balance Fulfilment Resources with Fulfilment Requirements: The process of developing a time-phased course of action that commits creation and operation resources to meet service delivery and operation requirements.

sP3.4 Establish Fulfilment Plans: The establishment of courses of action over specified time periods that represent a projected appropriation of supply resources to meet fulfilment and operating plan requirements.

Metrics

RS.1.1 Order Fulfilment Cycle Time

CO.2.001 Planning Cost

CO.3.001 Planning Labour Cost

CO.3.002 Planning Automation Cost

CO.3.003 Planning Property, Plant and Equipment Cost

CO.3.004 Planning GRC and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.4 sP4 Plan Deliver

The development and establishment of courses of action over specified time periods that represent a projected appropriation of delivery resources to meet delivery requirements.

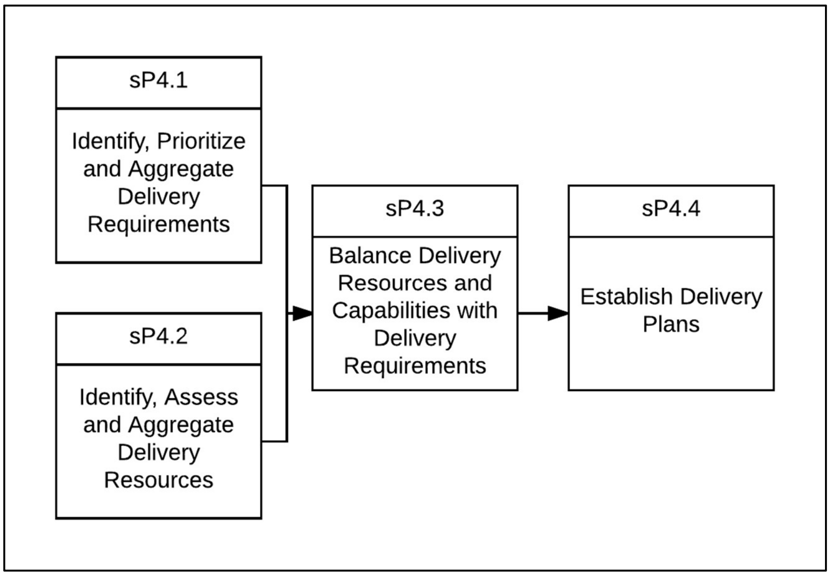

Figure 29: sP4 Plan Deliver

Hierarchy

sP4.1 Identify, Prioritize and Aggregate Delivery Requirements: The process of identifying, prioritizing, and considering, as a whole with constituent services, all sources of demand in the delivery of a service.

sP4.2 Identify, Assess and Aggregate Delivery Resources: The process of identifying, evaluating, and considering, as a whole with constituent services, all things that add value in the delivery of a service.

sP4.3 Balance Delivery Resources and Capabilities with Delivery Requirements: The process of developing a time-phased course of action that commits delivery resources to meet delivery requirements.

sP4.4 Establish Delivery Plans: The establishment of courses of action over specified time periods that represent a projected appropriation of delivery resources to meet delivery requirements.

Metrics

RS.1.1 Order Fulfilment Cycle Time

CO.2.001 Planning Cost

CO.3.001 Planning Labour Cost

CO.3.002 Planning Automation Cost

CO.3.003 Planning Property, Plant and Equipment Cost

CO.3.004 Planning GRC and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.5 sP5 Plan Return

A strategic or tactical process to establish and adjust courses of action or tasks over specified time periods that represent a projected appropriation of return resources to meet unanticipated return requirements. The scope includes the return of items of work to the previous step in the supply chain process after the previous step had not been completed sufficiently.

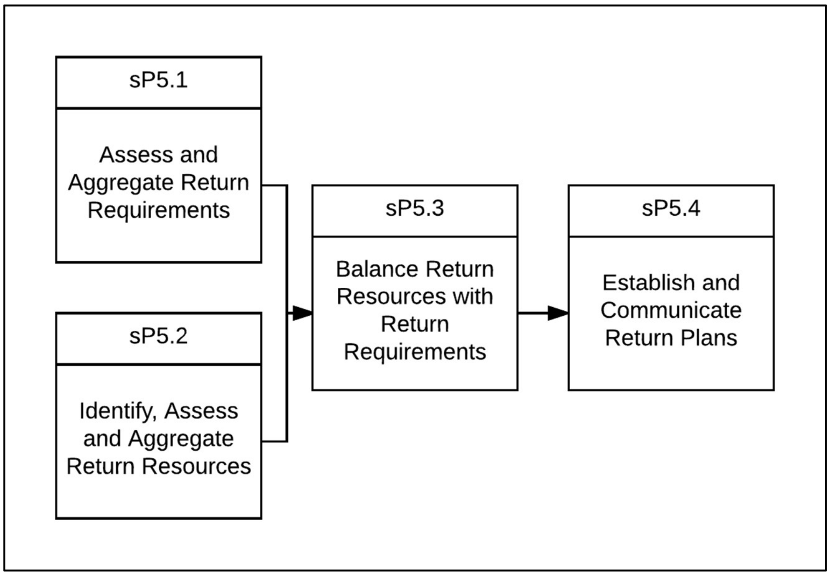

Figure 30: sP5 Plan Return

Hierarchy

sP5.1 Assess and Aggregate Return Requirements: The process of identifying, evaluating, and considering, as a whole with constituent services, all sources of demand for the return of a service.

sP5.2 Identify, Assess and Aggregate Return Resources: The process of identifying, evaluating, and consideration for all resources that add value to, execute, or constrain the processes for the return of a service.

sP5.3 Balance Return Resources with Return Requirements: The process of developing courses of action that make feasible the commitment the appropriate return resources and or assets to satisfy return requirements.

sP5.4 Establish and Communicate Return Plans: The establishment and communication of courses of action over specified time periods that represent a projected appropriation of required return resources and or assets to meet return process requirements.

Metrics

RS.1.1 Order Fulfilment Cycle Time

CO.2.001 Planning Cost

CO.3.001 Planning Labour Cost

CO.3.002 Planning Automation Cost

CO.3.003 Planning Property, Plant and Equipment Cost

CO.3.004 Planning GRC and Overhead Cost

A.6 sR1 Request Scheduled Service

The processes receiving the inputs to a service ordered (and may be configured) only when required by a specific customer order that can be scheduled for a future time. The intention Request Scheduled Service is to ensure sufficient resources specifically for customer orders that may be scheduled for a future date. The information is received and tracked using a customer order reference (order number or request number). The request is typically identifiable throughout the request process, by the reference to the customer order associated to the request.

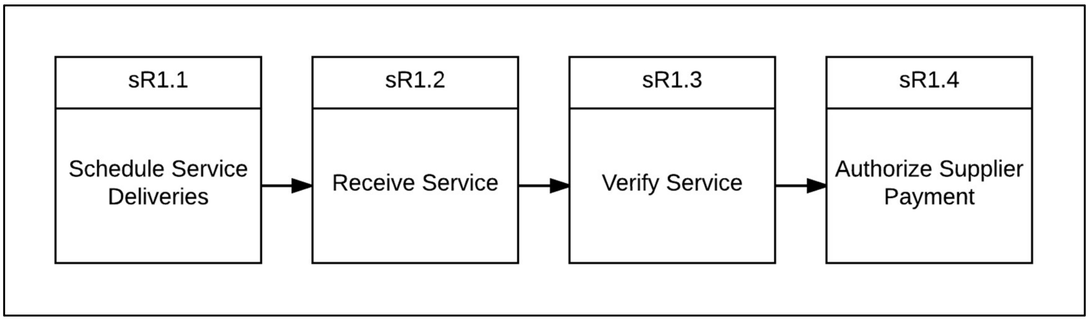

Figure 31: sR1 Request Scheduled Service

Hierarchy

sR1.1 Schedule Service Deliveries: Scheduling and managing the execution of the individual deliveries of services against the contract. The requirements for service deliveries are determined based on the detailed sourcing plan. This includes all aspects of managing the contract schedule including service level agreements, qualifications or service deployment.

sR1.2 Receive Service: The process and associated activities of receiving service to contract requirements.

sR1.3 Verify Service: The process and actions required determining service conformance to requirements and criteria.

sR1.4 Authorize Supplier Payment: The process of authorizing payments and paying suppliers for services. This process includes invoice collection, invoice matching (to delivered service) and the issuance of checks.

Metrics

RL.1.1 Perfect Order Fulfilment

RS.1.1 Order Fulfilment Cycle Time

RS.2.1 Request Cycle Time

CO.2.002 Request Cost

CO.3.005 Request Labour Cost

CO.3.006 Request Automation Cost

CO.3.007 Request Property, Plant and Equipment Cost

CO.3.008 Request GRC, Inventory and Overhead Cost

CO.2.003 Service Acquisition Cost

CO.3.009 Purchased Service Cost

CO.3.010 Service Transportation Cost

CO.3.011 Service Customs, Duties, Taxes and Tariffs Cost

CO.3.012 Service Risk and Compliance Cost

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

AM.2.3 Days Payable Outstanding

A.7 sR2 Request Unscheduled Service

The processes receiving the inputs to a service ordered (and may be configured) only when required by a specific customer order that has to be attended to as soon as possible without the option of scheduling the service for a future date. The intention Request Unscheduled Service is to ensure sufficient resources specifically for customer orders that may be scheduled for a future date. The information is received and tracked using a customer order reference (order number, incident number or event number). The request is typically identifiable throughout the incident or event process, by the reference to the customer order associated to the event. Unscheduled services are typically associated to an event or incident requiring immediate attention rather than a request.

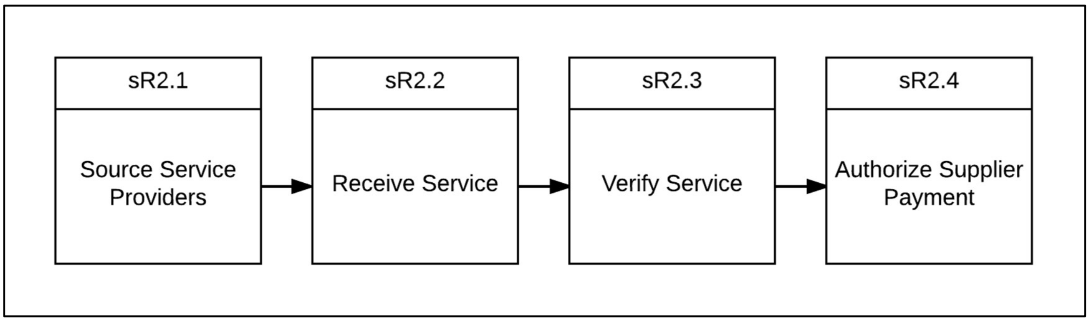

Figure 32: sR2 Request Unscheduled Service

Hierarchy

sR2.1 Source Service Providers: Arranging for the required service providers to fulfil the unscheduled service. Service provider execution is then scheduled and executed to the execution of the individual deliveries of services against the contract. The requirements for service deliveries are determined based on the detailed sourcing plan. This includes all aspects of managing the contract schedule including service level agreements, qualifications or service deployment.

sR2.2 Receive Service: The process and associated activities of receiving service to contract requirements.

sR2.3 Verify Service: The process and actions required determining service conformance to requirements and criteria.

sR2.4 Authorize Supplier Payment: The process of authorizing payments and paying suppliers for services. This process includes invoice collection, invoice matching (to delivered service) and the issuance of checks.

Metrics

RL.1.1 Perfect Order Fulfilment

RS.1.1 Order Fulfilment Cycle Time

RS.2.1 Source Cycle Time

CO.2.002 Request Cost

CO.3.005 Request Labour Cost

CO.3.006 Request Automation Cost

CO.3.007 Request Property, Plant and Equipment Cost

CO.3.008 Request GRC, Inventory and Overhead Cost

CO.2.003 Service Acquisition Cost

CO.3.009 Purchased Service Cost

CO.3.010 Service Transportation Cost

CO.3.011 Service Customs, Duties, Taxes and Tariffs Cost

CO.3.012 Service Risk and Compliance Cost

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

AM.2.3 Days Payable Outstanding

A.8 sR3 Request Engineered Service

The processes of identifying and selecting sources of supply, negotiating, validating, scheduling, ordering and receiving services that are designed, ordered and/or fulfilled based on the requirements or specifications of a specific customer order.

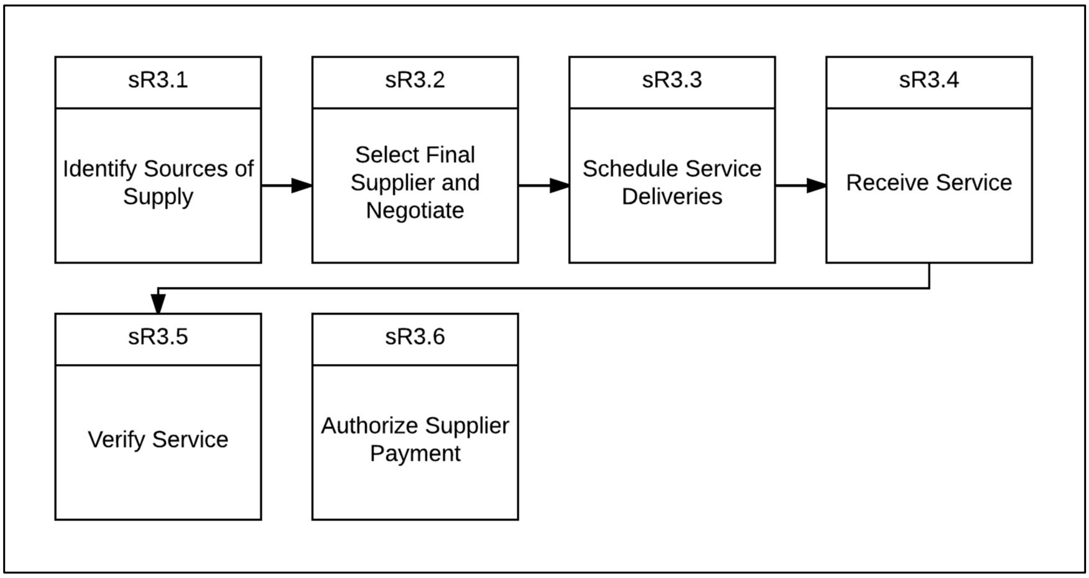

Figure 33: sR3 Request Engineered Service

Hierarchy

sR3.1 Identify Sources of Supply: The identification and qualification of potential suppliers capable of designing and delivering the service that will meet all of the required service specifications.

sR3.2 Select Final Supplier and Negotiate: The identification of the final supplier(s) based on the evaluation of RFQs, supplier qualifications and the generation of a contract defining the costs and terms and conditions of service availability.

sR3.3 Schedule Service Deliveries: Scheduling and managing the execution of the individual deliveries of services against the contract. The requirements for service deliveries are determined based on the detailed sourcing plan. This includes all aspects of managing the contract schedule including service levels and qualifications.

sR3.4 Receive Service: The process and associated activities of receiving service to contract requirements.

sR3.5 Verify Service: The process and actions required determining service conformance to requirements and criteria.

sR3.6 Authorize Supplier Payment: The process of authorizing payments and paying suppliers for services. This process includes invoice collection, invoice matching and the issuance of checks.

Metrics

RL.1.1 Perfect Order Fulfilment

RS.1.1 Order Fulfilment Cycle Time

RS.2.1 Source Cycle Time

CO.2.002 Request Cost

CO.3.005 Request Labour Cost

CO.3.006 Request Automation Cost

CO.3.007 Request Property, Plant and Equipment Cost

CO.3.008 Request GRC, Inventory and Overhead Cost

CO.2.003 Service Acquisition Cost

CO.3.009 Purchased Service Cost

CO.3.010 Service Transportation Cost

CO.3.011 Service Customs, Duties, Taxes and Tariffs Cost

CO.3.012 Service Risk and Compliance Cost

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

AM.2.3 Days Payable Outstanding

A.9 sF1 Fulfil Scheduled Service

The process of fulfilling services in a standardised back office environment adds value to a customer request or order through steps that are limited in range for a specific customer order. Time is available in a scheduled service to ensure that sufficient capacity is available at a future date to meet the requirements of delivering the services sufficiently. Services are completed, in response to a customer order, the customer order reference is associated to the order, and referenced when transferring the output to Deliver.

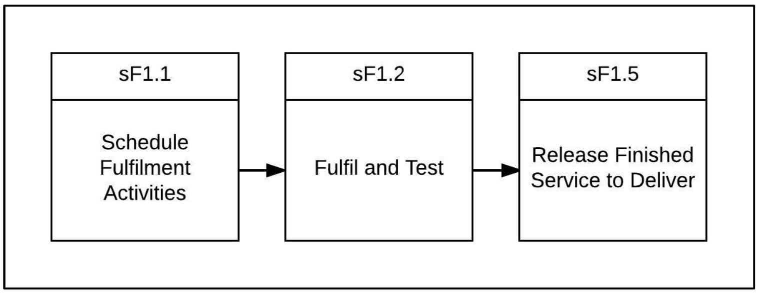

Figure 34: sF1: Fulfil Scheduled Service

Hierarchy

sF1.1 Schedule Fulfilment Activities: Fulfilment of the service through the scheduled service that are to be delivered in finalising the final scheduled service.

sF1.2 Fulfil and Test: The series of activities performed upon sourced services to a state of completion and greater value. The processes associated with the validation of service performance to ensure conformance to defined specifications and requirements.

sF1.5 Release Finished Service to Deliver: Activities associated with post-fulfilment documentation, testing, or certification required prior to delivery of finished service to customer.

Metrics

RL.1.1 Perfect Order Fulfilment

RS.2.2 Fulfil Cycle Time

AG.2.2 Upside Make Flexibility

AG.2.7 Upside Make Adaptability

AG.2.12 Downside Make Adaptability

CO.2.004 Service Fulfilment Cost

CO.3.014 Service Fulfilment (Direct) Labour Cost

CO.3.015 Service Fulfilment Automation Cost

CO.3.016 Service Fulfilment Property, Plant and Equipment Cost

CO.3.017 Service Fulfilment GRC, Inventory and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.10 sF2 Fulfil Unscheduled Service

The process of fulfilling services in a standardised back office environment adds value to a customer request or order through steps that are limited in range for a specific customer order. The unscheduled nature results in any available resources to be applied to delivering the service and any shortage to capacity results in a delay in delivering the service. Services are completed, in response to a customer order, the customer order reference is associated to the order, and referenced when transferring the output to Deliver.

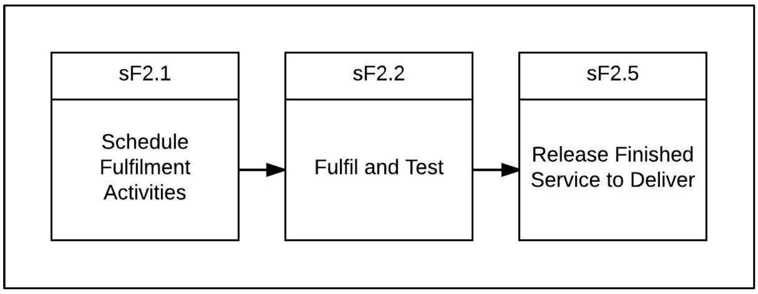

Figure 35: sF2 Fulfil Unscheduled Service

Hierarchy

sF2.1 Schedule Fulfilment Activities: Fulfilment of the service through the scheduled service that are to be delivered in finalising the final scheduled service. In the case of Unscheduled services, not all the supporting services may be known or available. This process must determine that sufficient services are available that may fulfil the request or that there are steps available where the completed services can be stored to wait for supporting services that are not immediately available.

sF2.2 Fulfil and Test: The series of activities performed upon sourced services to a state of completion and greater value. The processes associated with the validation of service performance to ensure conformance to defined specifications and requirements. Services that await further supporting process need to be stored or staged pending the fulfilment of dependent services.

sF2.5 Release Finished Services to Deliver: Activities associated with post-fulfilment documentation, testing, or certification required prior to delivery of finished service to customer.

Metrics

RL.1.1 Perfect Order Fulfilment

RS.2.2 Make Cycle Time

AG.2.2 Upside Make Flexibility

AG.2.7 Upside Make Adaptability

AG.2.12 Downside Make Adaptability

CO.2.004 Service Fulfilment Cost

CO.3.014 Service Fulfilment (Direct) Labour Cost

CO.3.015 Service Fulfilment Automation Cost

CO.3.016 Service Fulfilment Property, Plant and Equipment Cost

CO.3.017 Service Fulfilment GRC, Inventory and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

AM.3.17 Inventory Days of Supply – WIP

AM.3.22 Recyclable waste as % of total waste

A.11 sF3 Fulfil Engineered Service

The process of developing, designing, validating, and ultimately executing a process to fulfil services based on the requirements of a specific customer. In general, Fulfil Engineered Service requires that work instructions may need to be defined or refined and specific suppliers and work packages need to be assembled or modified in completing the specific customer request.

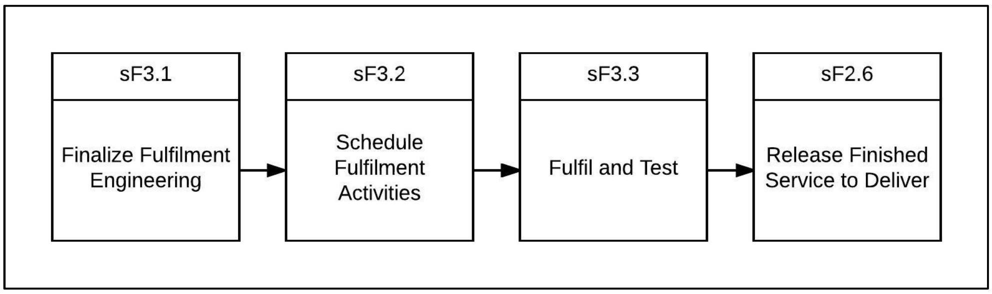

Figure 36: sF3 Fulfil Engineered Service

Hierarchy

sF3.1 Finalize Fulfilment Engineering: Engineering activities required after acceptance of order, but before service can be fulfilled. In general, the last step in the completion of any preliminary design work done as part of the quotation process.

sF3.2 Schedule Fulfilment Activities: The scheduling of the operations to be performed in accordance with the designs and plans for fulfilment.

sF3.3 Fulfil and Test: The series of activities performed upon sourced services to a state of completion and greater value. The processes associated with the validation of service performance to ensure conformance to defined specifications and requirements. Services that await further supporting process need to be stored or staged pending the fulfilment of dependent services.

sF3.6 Release Finished Services to Deliver: Activities associated with post-fulfilment documentation, testing, or certification required prior to delivery of finished service to customer.

Metrics

RL.1.1 Perfect Order Fulfilment

RS.1.1 Order Fulfilment Cycle Time

RS.2.2 Make Cycle Time

AG.2.2 Upside Make Flexibility

AG.2.7 Upside Make Adaptability

AG.2.12 Downside Make Adaptability

CO.2.004 Service Fulfilment Cost

CO.3.014 Service Fulfilment (Direct) Labour Cost

CO.3.015 Service Fulfilment Automation Cost

CO.3.016 Service Fulfilment Property, Plant and Equipment Cost

CO.3.017 Service Fulfilment GRC, Inventory and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.12 sD1 Deliver Scheduled Service

The processes of delivering services that have been fulfilled in response to a specific firm customer order. A reference to the customer order is exchanged with the request and fulfilment process and associated to the service.

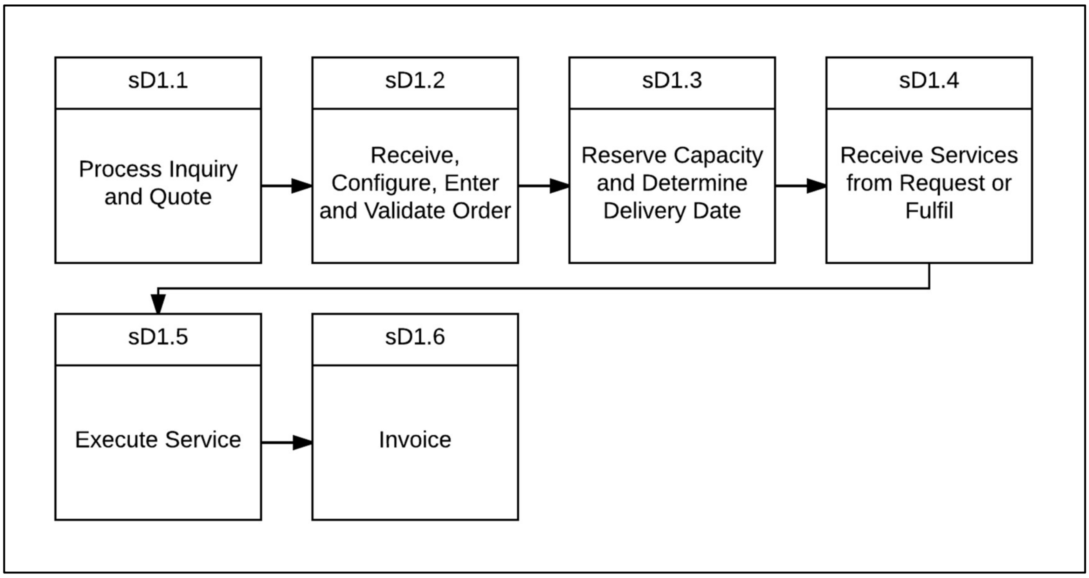

Figure 37: D1 Deliver Scheduled Service

Hierarchy

sD1.1 Process Inquiry and Quote: Receive and respond to general customer inquiries and requests for quotes.

sD1.2 Receive, Configure, Enter and Validate Order: Receive orders from the customer and enter them into a company's order processing system. Orders can be received through phone, fax, or through electronic media. Configure your service to the customer's specific needs, based on standard available options. 'Technically' examine order to ensure an orderable configuration and provide accurate price. Check the customer's credit. Optionally accept payment.

sD1.3 Reserve Capacity and Determine Delivery Date: Inventory and/or planned capacity is identified and reserved for specific orders, and a delivery date is committed and scheduled.

sD1.4 Receive Services from Source or Fulfil: The activities such as receiving services, verifying, recording service receipt. May include quality inspection.

sD1.5 Execute Service: The process of preparing, testing and fulfilling the service to the customer. The service is fully functional upon completion.

sD1.6 Invoice: A signal is sent to the financial organization that the order has been fulfilled and that the billing process should begin and payment be received or be closed out if payment has already been received. Payment is received from the customer within the payment terms of the invoice.

Metrics

RL.1.1 Perfect Order Fulfilment

RS.1.1 Order Fulfilment Cycle Time

RS.2.3 Deliver Cycle Time

AG.2.3 Upside Deliver Flexibility

AG.2.8 Upside Deliver Adaptability

AG.2.13 Downside Deliver Adaptability

CO.2.005 Order Management Cost

CO.3.018 Order Management Labour Cost

CO.3.019 Order Management Automation Cost

CO.3.020 Order Management Property, Plant and Equipment Cost

CO.3.021 Order Management GRC and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.13 sD2 Deliver Unscheduled Service

The processes of delivering services that have been fulfilled in response to a specific firm customer order. A reference to the customer order is exchanged with the request and fulfilment process and associated to the service.

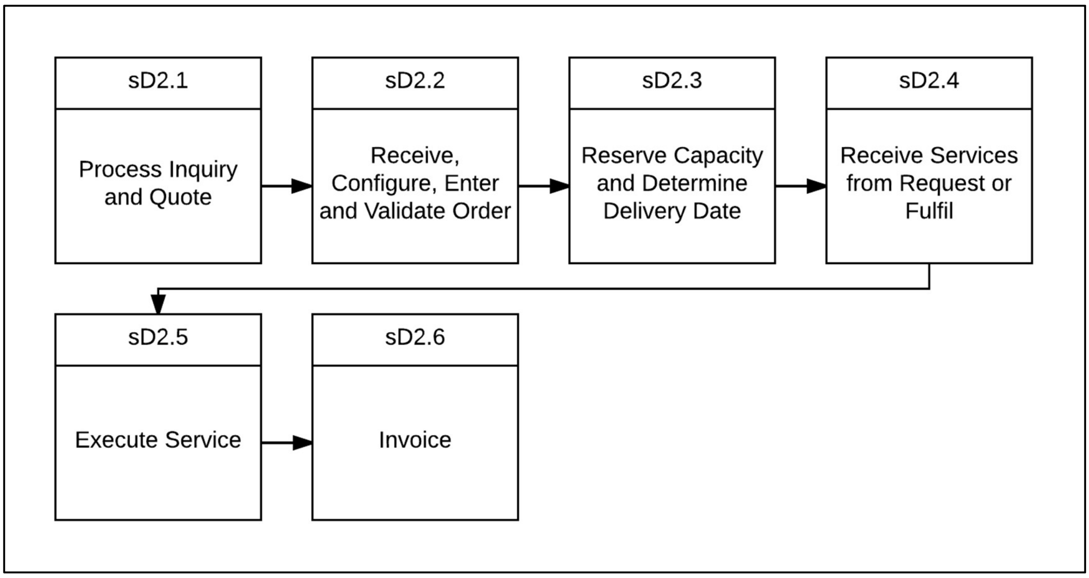

Figure 38: sD2 Deliver Unscheduled Service

Hierarchy

sD2.1 Process Inquiry and Quote: Receive and respond to general customer inquiries and requests for quotes.

sD2.2 Receive, Configure, Enter and Validate Order: Receive orders from the customer and enter them into a company's order processing system. Orders can be received through phone, fax, or through electronic media. Configure your service to the customer's specific needs, based on standard available options. 'Technically' examine order to ensure an orderable configuration and provide accurate price. Check the customer's credit. Optionally accept payment.

sD2.3 Reprioritise Capacity and Determine Delivery Date: Inventory and/or planned capacity is identified and reserved for specific orders, and a delivery date is committed and scheduled. This may be based on spare capacity being available or re prioritising existing capacity to meet the unscheduled request.

sD2.4 Receive Services from Request or Fulfil: The activities such as receiving services, verifying, recording service receipt. May include quality inspection.

sD2.5 Execute Service: The process of preparing, testing and fulfilling the service to the customer. The service is fully functional upon completion.

sD2.6 Invoice: A signal is sent to the financial organization that the order has been fulfilled and that the billing process should begin and payment be received or be closed out if payment has already been received. Payment is received from the customer within the payment terms of the invoice.

Metrics

RL.1.1 Perfect Order Fulfilment

RS.1.1 Order Fulfilment Cycle Time

RS.2.3 Deliver Cycle Time

AG.2.3 Upside Deliver Flexibility

AG.2.8 Upside Deliver Adaptability

AG.2.13 Downside Deliver Adaptability

CO.2.005 Order Management Cost

CO.3.018 Order Management Labour Cost

CO.3.019 Order Management Automation Cost

CO.3.020 Order Management Property, Plant and Equipment Cost

CO.3.021 Order Management GRC and Overhead Cost

CO.3.028 Discounts and Refunds CostAM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.14 sD3 Deliver Engineered Service

The process of obtaining, responding to, and allocating resources for a customer order that has unique requirements or specifications and delivering a service that is partially or fully designed, redesigned, and fulfilled from a design that includes one or more customised designs. Design will begin only after the receipt and validation of a firm customer order.

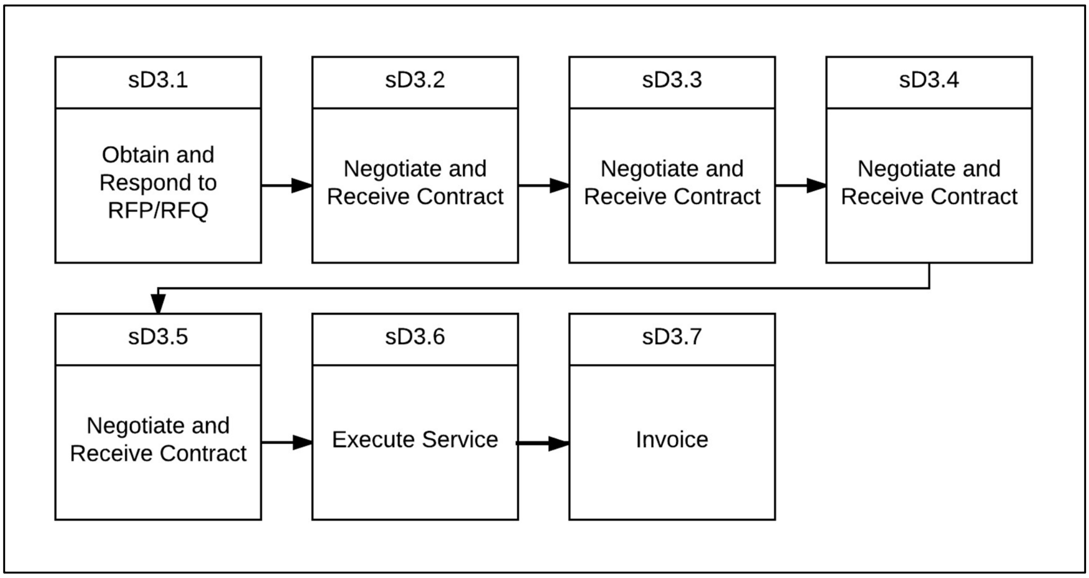

Figure 39: sD3 Deliver Engineered Service

Hierarchy

sD3.1 Obtain and Respond to RFP/RFQ: The process of receiving a request for proposal or request for quote, evaluating the request (estimating the schedule, developing costs estimates, establishing price), and responding to the potential customer.

sD3.2 Negotiate and Receive Contract: The process of negotiating order details with customer (e.g., price, schedule, service level agreements) and finalizing the contract. Optionally accept payment.

sD3.3 Enter Order, Commit Resources & Launch Program: The process of entering/finalizing the customer's order, approving the planned resources and officially launching the program.

sD3.4 Schedule Execution: The process of evaluating the design and fulfilment schedules relative to customer requested completion date to determine execution schedule.

sD3.5 Receive Services from Request or Fulfil: The activities such as receiving services, verifying, recording service receipt. May include quality inspection.

sD3.6 Execute Service: The process of preparing, testing and fulfilling the service to the customer. The service is fully functional upon completion.

sD3.7 Invoice: A signal is sent to the financial organization that the order has been fulfilled and that the billing process should begin and payment be received or be closed out if payment has already been received. Payment is received from the customer within the payment terms of the invoice.

Metrics

RL.1.1 Perfect Order Fulfilment

RS.1.1 Order Fulfilment Cycle Time

RS.2.3 Deliver Cycle Time

AG.2.3 Upside Deliver Flexibility

AG.2.8 Upside Deliver Adaptability

AG.2.13 Downside Deliver Adaptability

CO.2.005 Order Management Cost

CO.3.018 Order Management Labour Cost

CO.3.019 Order Management Automation Cost

CO.3.020 Order Management Property, Plant and Equipment Cost

CO.3.021 Order Management GRC and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.15 sRR1 Request Return Service

The return and disposition determination of services that do not meet the requirements specified of the service based on the service standards. The Return Service supports any type of service not conforming to specifications (including order non-conformance such as late or otherwise improper delivery); company business rules determine the definition of 'defective'.

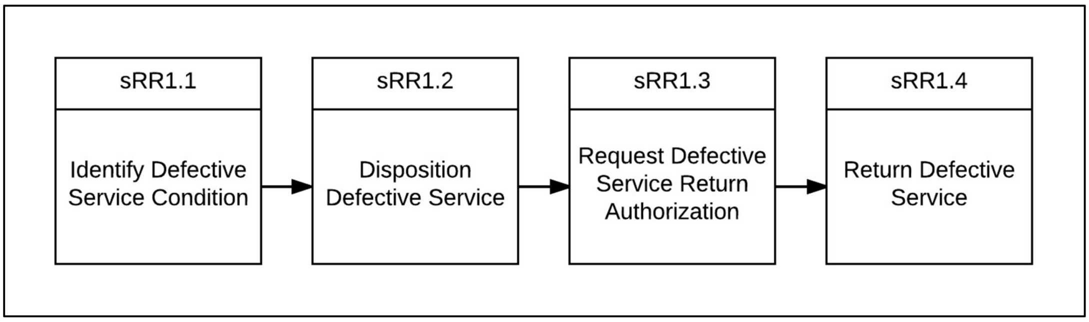

Figure 40: sRR1 Request Return Service

Hierarchy

sRR1.1 Identify Defective Service Condition: The process where the customer utilizes planned policies, business rules and service level agreements and service specifications as criteria to identify and confirm that service is defective.

sRR1.2 Disposition Defective Service: The process of the customer determining whether to return the defective service and the appropriate source contact for a return authorization.

sRR1.3 Request Defective Service Return Authorization: The process of a customer requesting and obtaining authorization, from last known holder or designated return centre, for the return of defective service.

sSR1.4 Return Defective Service: The process where the customer transfers control of the defective service to the appropriate party.

Metrics

RS.1.1 Order Fulfilment Cycle Time

CO.2.007 Returns Cost

CO.3.030 Return GRC, Inventory and Overhead Cost

AM.1.1 Cash-To-Cash Cycle Time

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.16 sDR1 Deliver Return Service

The receipt and disposition determination of defective services that do not meet the requirements specified of the service based on the service standards. The Return Service supports any type of service not conforming to specifications (including order non-conformance such as late or otherwise improper delivery); company business rules determine the definition of 'defective'.

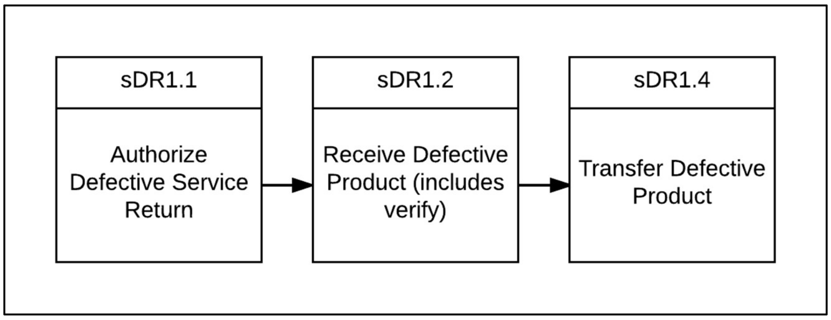

Figure 41: sDR1 Deliver Return Service

Hierarchy

sDR1.1 Authorize Defective Service Return: The process where the last known holder or designated return centre receives a defective service return authorization request from a customer, determines if the service can be accepted and communicates decision to the customer. Accepting the request would include negotiating the conditions of the return with the customer. Rejecting the request would include providing a reason for the rejection to the customer.

sDR1.2 Receive Defective Service (includes verify): The process where the last known holder or designated return centre receives and verifies the returned defective service against the return authorization and other documentation.

sDR1.4 Transfer Defective Service: The process where the last known holder or designated return centre transfers the defective service to the appropriate process to implement the corrective actions.

Metrics

RS.1.1 Order Fulfilment Cycle Time

CO.2.002 Request Cost

CO.2.005 Order Management Cost

CO.2.007 Returns Cost

AM.1.2 Return on Supply Chain Fixed Assets

AM.1.3 Return on Working Capital

A.17 sE1 Manage Supply Chain Business Rules

The process of establishing, documenting, communicating and publishing supply chain business rules. A business rule is a statement or parameter that defines or constrains some aspect of the business and is generally used in decision-making. Business rules are intended to influence the outcomes of operating the supply chain. Business rules can apply to people, processes, corporate behaviour and computing systems in an organization, and are put in place to help the organization achieve its goals.

An example business rule may state "no returns accepted without a return authorization". Types of supply chain business rules include:

- Performance goals
- Planning rules such as frequency, horizon and level of plans
- Sourcing rules such as approved suppliers, blacklisted suppliers

Note: sE1 Manage Business Rules generally does not develop policies; it translates policies into business rules applied to supply chain processes.

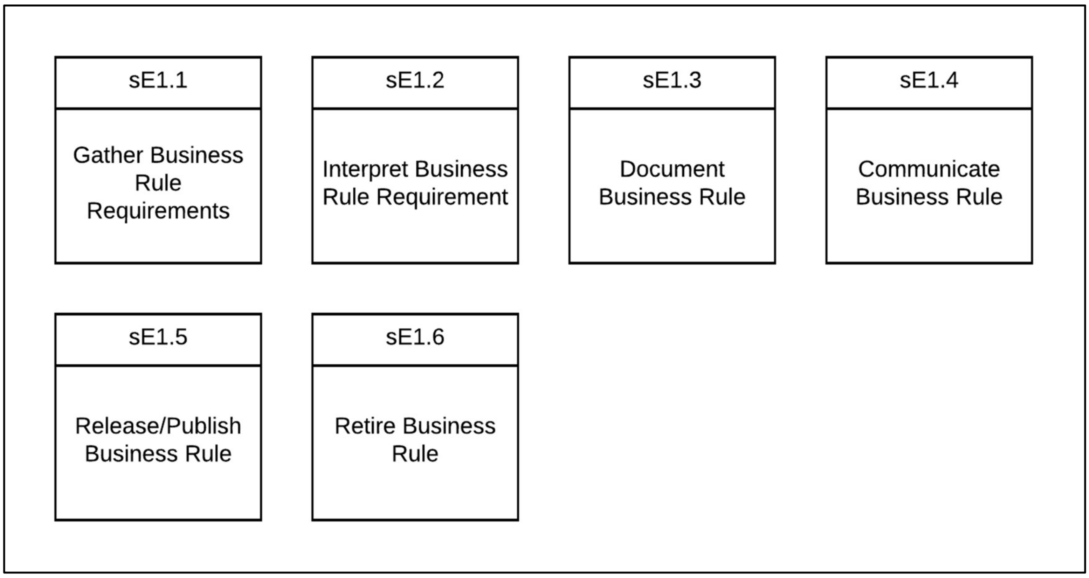

Figure 42: sE1 Manage Supply Chain Business Rules

Hierarchy

sE1.1 Gather Business Rule Requirements: The process of collecting, organizing, prioritizing and scheduling policies and directives requiring new supply chain business rules, changes to business rules or discontinuation of business rules. This may include scheduling and assigning activities to responsible individuals, groups or organizations.

sE1.2 Interpret Business Rule Requirement: The process of determining how the policy or directive impacts supply chain processes, technology and business rules. This includes reviewing existing business rules and determining the need to add, change or delete business rules. The outcome is one or more of the following:

- Request to Add a Business Rule
- Request to Change a Business Rule
- Request to Delete or Archive a Business Rule

The purpose of this step is to identify the type of activities required and routing the request if required.

sE1.3 Document Business Rule: The process of writing the business rule in the appropriate system of record. This includes adding, editing and deleting policy and process documentation. A business rule includes a directive or policy, scope and effective date. Updates to existing business rules may include discontinuation information.

The final activity of Document Business Rule is obtaining formal approval. The output of this process step is a fully documented business rule that is signed off by the responsible function.

sE1.4 Communicate Business Rule: The process of creating awareness in the relevant organization and/or staff of the upcoming changes. This may include communications, training and education programs. A notice could be sufficient for small or incremental changes.

sE1.5 Release/Publish Business Rule: The process of activating the business rule. Business rules release may be time-phased --e.g. Changes in pricing schedules for services. This may include activation of a business rule in a software algorithm and starting to use a new or updated standard operating procedure. For large impact business rule changes this may include updating external websites, formal announcements, etc.

sE1.6 Retire Business Rule: The process of de-activating the business rule. Business rules retirement may be time-phased --e.g. Bill of Materials replaced by newer revisions. This may include archiving the business rule in the associated software to avoid users from inadvertently using it or in order to comply to regulatory requirements or policies.

A.18 sE2 Manage Performance

The process of reporting performance, identifying gaps in performance, performing root cause analysis, and developing and launching corrective actions to close gaps in performance. This process describes all versions of managing supply chain performance.

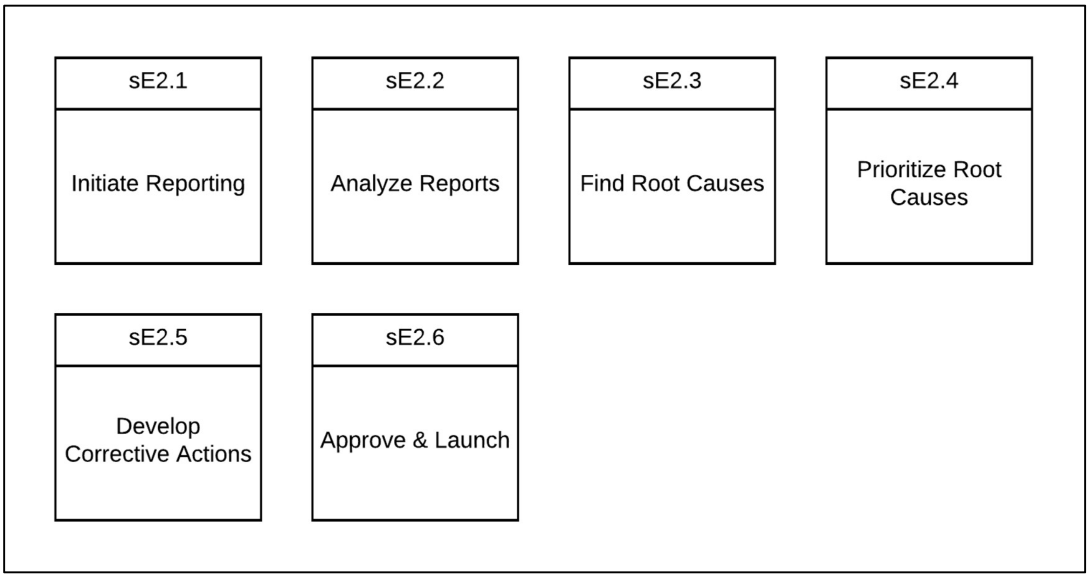

Figure 43: sE2 Manage Performance

Hierarchy

sE2.1 Initiate Reporting: The process of scheduling, running reports, collecting and aggregating performance data. This includes running standard (pre-defined) reports as well as ad hoc reporting. Ad hoc reporting includes developing a data collection plan and organizing data collection through:

- Inspections

- Measurement (e.g. stopwatch to measure duration of activities)
- Sampling
- Self-assessments (e.g. Baldridge Self-Assessment)

Note: Today reports may be delivered (pushed) to the user by electronic media. This process step represents the delivery of reports to the user in such scenarios.

sE2.2 Analyse Reports: The process of reviewing the reported performance. This includes comparing actual performance and trends to targets set for each metric. Identify metrics that require root cause analysis and notification/scheduling of process owners or 'root cause analysis' resources.

sE2.3 Find Root Causes: The process of analysing the gaps in performance. Example root cause finding methods and techniques include:

- Adding commentary to reported data
- Metrics decomposition using diagnostic relationships of (SCOR) metrics
- Time studies, sampling, audits, cycle counting
- 5-Whys/Cause & Effect analysis
- Statistical Analysis Techniques: e.g. Histogram, Scatter Plots, ANOVA

All root causes are documented and quantified. Quantification is the calculation or estimation of the relative contribution to the gap in performance.

sE2.4 Prioritize Root Causes: The process of sorting root causes by relative contribution and prioritizing root causes. This includes assigning root causes to resources and scheduling development of corrective actions.

sE2.5 Develop Corrective Actions: The process of identifying, documenting and testing corrective actions to address the root cause in order to close the performance gap. Corrections actions include:

- Organizational changes (hiring, redeployment)
- Policy changes (business rules)
- Process improvements (work instructions, training)
- Supply chain network reconfiguration
- Technology introduction (new equipment, tools, software)

Note: This list of corrective actions is a general characterization for example purposes only. Different root causes may require different corrective actions.

sE2.6 Approve & Launch: The process of obtaining approvals, prioritizing, communicating and launching the corrective actions.

A.19 sE3 Manage Data and Information

The process of collecting, maintaining and publishing data and information required to plan, operate, measure and manage the supply chain.

Examples of data elements include:

- Customer information - addresses, payment methods, customer pricing (pricelists), delivery methods
- Supplier information - addresses, whitelists, blacklists
- Product/service information - specifications, pricing,

Activities include adding, changing and deleting (archiving) information, maintaining user access (grant, revoke) and maintaining availability of the information (activate/deactivate).

Notes: Alternative name: Master Data Management (e.g. Vendor Data Management, Product Master Data Management)

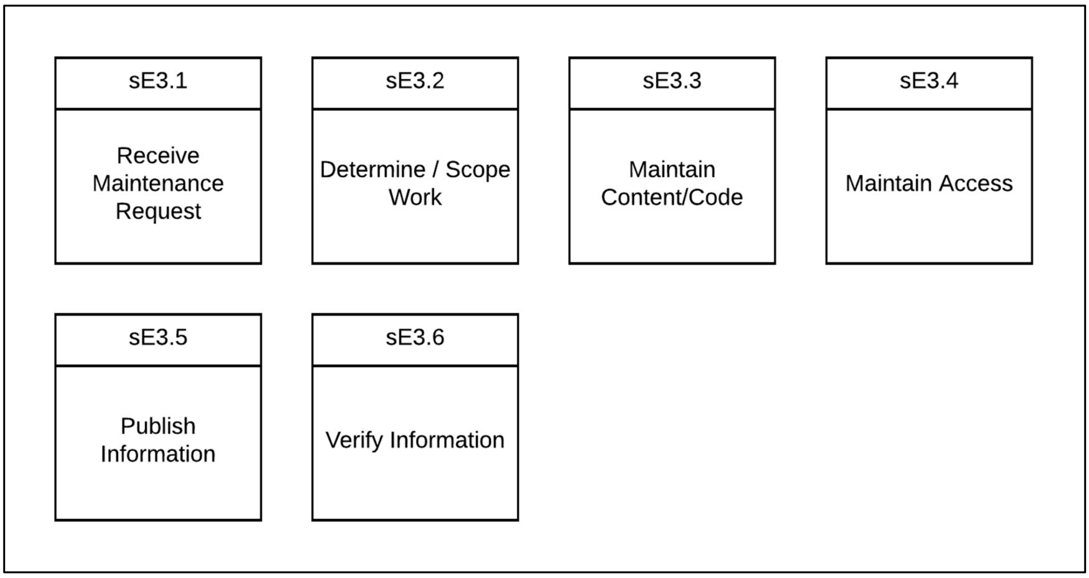

Figure 44: sE3 Manage Data and Information

Hierarchy

sE3.1 Receive Maintenance Request: The process of receiving, validating and logging the request for information, configuration or system functionality maintenance. Maintenance request types:

- Add data - creation of new record/document (includes duplicating existing records/documents)
- Change data - modification of an existing record/document
- Delete data - deletion of an existing record (includes archiving and 'unpublishing' existing records/documents)
- Change configuration (includes creating and maintaining user access)
- Add code - (includes installing software updates and security updates)
- Change code (modification of software code)
- Delete code

This process may include assigning a ticket, tracking or order number and routing the request to the appropriate resource.

sE3.2 Determine/Scope Work: The activities associated with determining the activities required to perform the requested maintenance. The requestor may be contacted for additional information. Complex requests may be setup as projects with appropriate work breakdown structure, milestones, acceptance criteria and deliverable schedules. This process may include routing the request to the appropriate resource.

sE3.3 Maintain Content/Code: The process of formatting, entering, loading, editing or deleting the information, software updates and code changes requested. This includes verification of changes as needed (unit and integration testing). Typical changes included are:

- Data record maintenance
- Configuration (system parameter) changes (such as activating and disabling system functionality)
- Loading/installing software updates (e.g. code changes from vendors or development groups)
- Loading/installing security updates

This process is not a placeholder for complex software engineering processes. Such processes would lay outside of the SCOR process framework

sE3.4 Maintain Access: The process of establishing, changing or removing access rights for users.

sE3.5 Publish Information: The process of activating the changes to information, configuration and/or code and populating the information to dependent systems, where applicable. For data record maintenance this is the activation of the new data and populating dependent systems with the new data.

sE3.6 Verify Information: The process of verifying the information is properly recorded in the system of record and populated to dependent systems. This includes verifying information is accessible to users.

A.20 sE4 Manage Supply Chain Human Resources

The process of developing, governing and maintaining an organization of permanent, temporary and outsourced staff, with the right qualifications, in support of the business objects and supply chain goals. This includes identifying required and available skills in the organization, determining gaps in skills and competency levels, identifying training needs, resource gaps and excess resources.

Note: This is a planning process to ensure staff (capacity) is available at the right levels. The actual training, hiring and redeployment is not part of this process as those are HR processes.

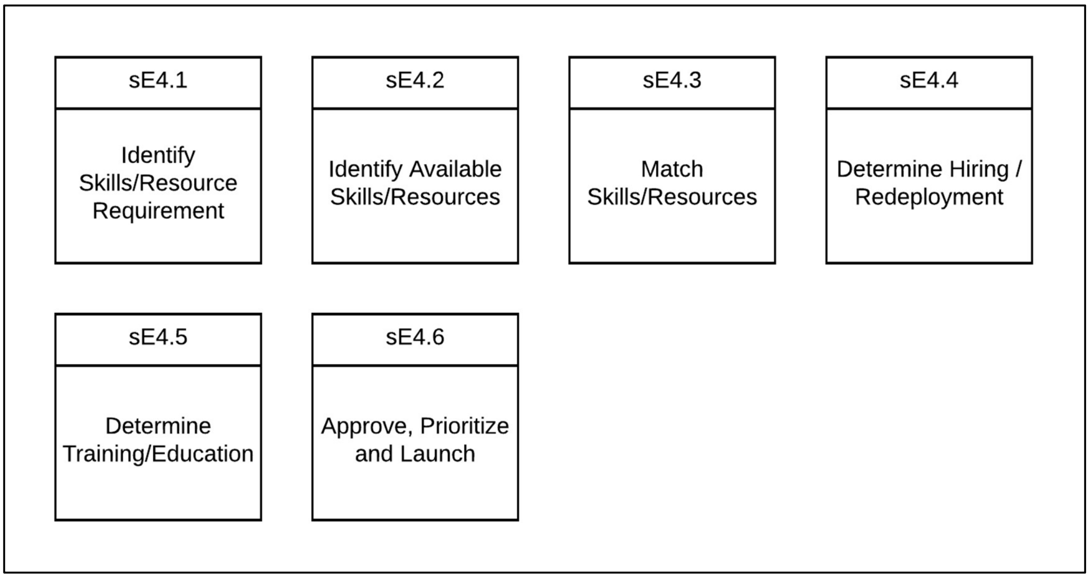

Figure 45: sE4 Manage Supply Chain Human Resources

Hierarchy

sE4.1 Identify Skills/Resource Requirement: The activities associated with the collection of the required skills to operate (part of) the supply chain. Examples of this process are planning meetings, periodic performance reviews, and reorganizations. The data collected should list the required skills and/or number of resources and is generally organized by entity (supply chain node, department, function or a combination of these).

sE4.2 Identify Available Skills/Resources: The activities associated with the collection of skills/resources currently available in the supply chain. Generally, this information is collected and organized by entity (supply chain node, department, function or a combination of these). Examples of this process include data collection for standard headcount reports, but should include temporary staff and outsourced resources.

sE4.3 Match Skills/Resources: The activities associated with the matching of skills or resource demand with the available skills/resources. The purpose of this process is to determine which skill/resource requirements (demand) can be met using existing resources, determine which skill/resource requirements are not supported by current available skills/resources (gap) and determine the skills/resources for which no demand exists (excess).

For each skill/resource gap or excess, one or more actions need to be identified to close the gap or address the excess:

- Training/Cross-training (add skills to existing resources)
- Hiring (add resources with existing skills)
- Redeployment (moving staff to different organizations or layoff)

It is important to consider the lead-time of these actions; scarce skills may have longer lead-times for example. Hiring includes temporary workers and all types of outsourced staff.

sE4.4 Determine Hiring/Redeployment: The activities associated with identification of sources of new hires or sources/destinations for redeployment. The purpose of this process step includes assessing the feasibility of hiring the required skills/resources within the required time period, assessing the feasibility of redeploying the excess employees (resources) and assessing the feasibility and impact of possible layoff of employees.

Note: At this stage this is a planning activity. The actual hiring process is not documented in SCOR, as this is a Human Resources Management (HR) process. Employee in this context includes temporary workers and employees of service providers.

sE4.5 Determine Training/Education: The activities associated with the identification of training and education programs to ensure existing (and newly hired) employees will have the appropriate skills to perform the work allocated to each individual employee. Employee in this definition may include temporary workers and employees of service providers.

sE4.6 Approve, Prioritize and Launch: The activities associated with obtaining approvals for hiring, redeployment, training and education plans, prioritizing and executing these plans. Additional resources and skills will become available over time, adjusting the labour component of capacity in Plan, Request, Fulfil, Deliver, Return and/or Enable processes.

A.21 sE5 Manage Supply Chain Assets

The process of scheduling, maintaining and dispositioning of supply chain assets that operate supply chain processes. This includes repair, alteration, calibration and other miscellaneous items to maintain service capabilities.

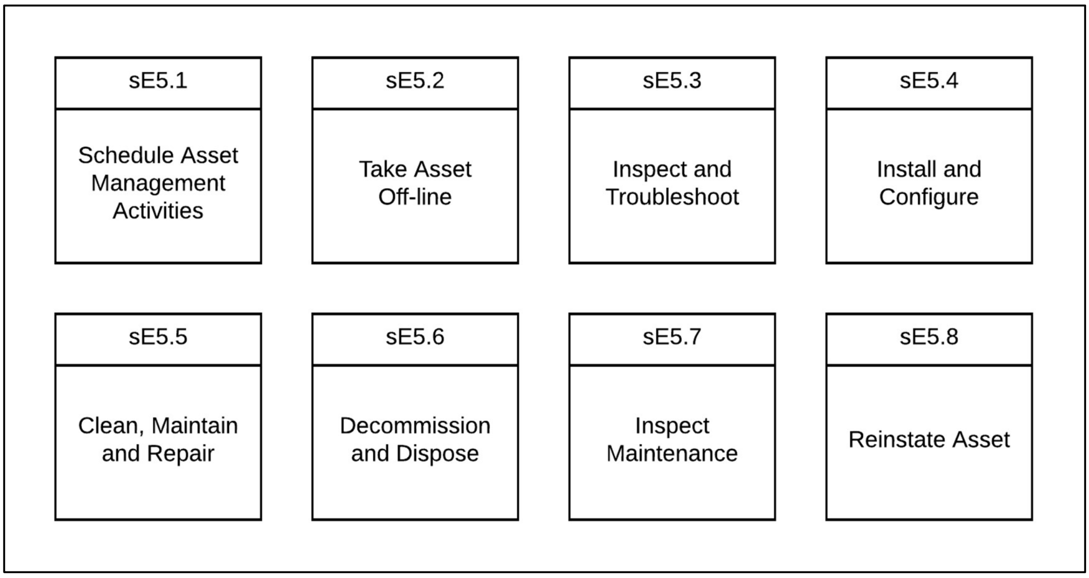

Figure 46: sE5 Manage Supply Chain Assets

Hierarchy

sE5.1 Schedule Asset Management Activities: The activities associated with receiving maintenance requests, receiving repair/replacement/ installation requests, maintaining preventive/regular maintenance tasks, scheduling individual maintenance tasks and assigning resources to individual maintenance tasks. Scheduling may include incorporating production and delivery plans and schedules and communication of maintenance schedules delivery planning and scheduling processes.

sE5.2 Take Asset Off-line: The activities associated with the preparation of the maintenance tasks. In general terms this means the asset or equipment needs to be stopped or put into maintenance mode. Safety precautions need to be made to ensure the equipment cannot be restarted during maintenance without active approval of the maintenance operators/engineers. This may include installing safety barriers, transporting the asset/equipment to a location where the maintenance will take place, removing deposits/materials from production equipment (cleaning), unloading transportation equipment and backing up data from the equipment and associated automation systems.

sE5.3 Inspect and Troubleshoot: The activities associated with assessing the overall status of the equipment, performing standard inspection and detailed troubleshooting if required. This includes identification of repairs, upgrade and maintenance tasks in order to bring the asset/equipment in optimal or acceptable working condition. This process may be the identification of readiness for installing new hardware or software and preparing (documenting) the steps of decommissioning and dispositioning for equipment/assets installation or de-installation and disposal.

sE5.4 Install and Configure: The activities associated with the installation of new hardware, software or functionality (equipment/ assets). This includes installation and initial testing of the new hardware, software or functionality. The general purpose of installation is to increase capacity or add/improve capabilities.

Note: This process step may trigger a separate supply chain (depending on the scale of the installation) building and installing new supply chain assets.

sE5.5 Clean, Maintain and Repair: The activities associated with the cleaning, replacement of parts, reconditioning of the equipment/ asset. (The general purpose of this process step is to bring the equipment/asset back in optimal/ acceptable operating condition). This may include measuring and testing of the equipment.

sE5.6 Decommission and Dispose: The activities associated with the de-installation and disposal of existing hardware, software or functionality (equipment/assets). This includes physical removal from the original point of use. The general purpose of installation is to replace capacity or remove outdated capabilities.

sE5.7 Inspect Maintenance: The activities associated with the inspection of the maintenance work performed. This may include performing test runs to assess whether new capacity or functionality is meeting expectations. This includes documentation of any inspection data, recording any inspection errors and obtaining approvals. The purpose of Inspect Maintenance is to verify the effectiveness/success of the maintenance activities.

sE5.8 Reinstate Asset: The activities associated with completion of the maintenance work and preparing the equipment/ asset to be brought 'on-line'. The general purpose of this process step is to make the asset available for 'production' (add to capacity). This includes closing work orders and receiving and approving payment of invoices for work performed by external resources. Upon completion of this process step the asset is expected to be in full working condition.

A.22 sE6 Manage Supply Chain Contracts

The management and communication of contractual agreements in support of business objectives and supply chain goals. This includes all contractual agreements related to supply chain operations, including: contracts for services such as maintenance, temporary staff, IT services, transportation and lease of buildings and equipment, contract manufacturing, logistics service providers and customer contracts.

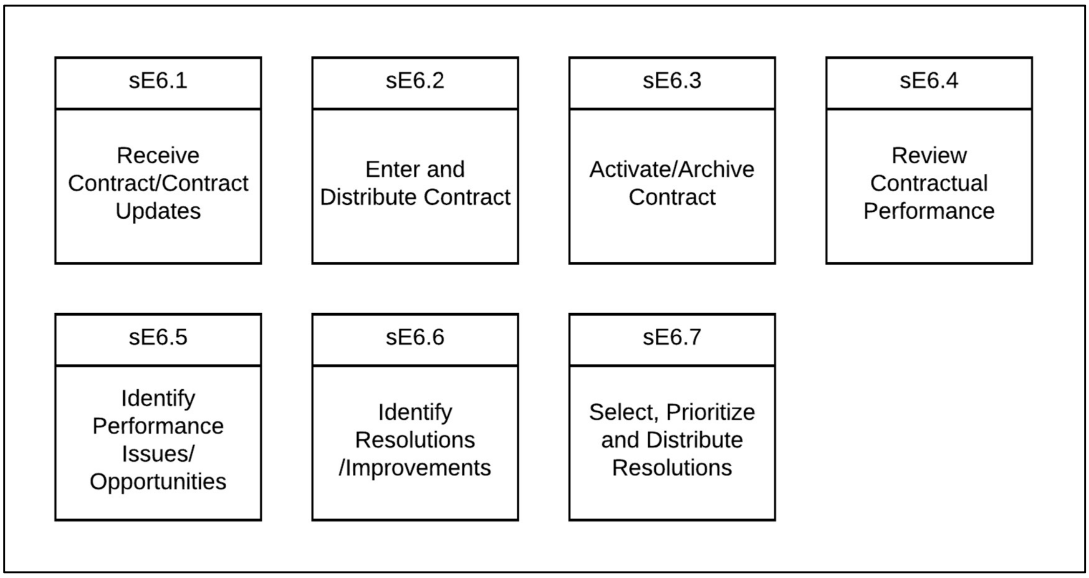

Figure 47: sE6 Manage Supply Chain Contracts

Hierarchy

sE6.1 Receive Contract/Contract Updates: The activities associated with receiving new contracts or changes to existing contracts. These contract updates may originate in Sales & Support processes (customer contracts) or in Product and Process Design processes (for material supplier or services providers such as transportation services, equipment maintenance services, IT services). This includes validation of contracts against criteria (business rules). A contract needs to include information such as effective date and duration, customer or supplier address and payment terms and may not be in conflict with business rules (and regulatory requirements).

sE6.2 Enter and Distribute Contract: The activities associated with entering contractual information in document management systems and ERP systems. This includes the 'translation' of contractual language/information into a format that the system can comprehend. A final step in this process is to distribute the contract or updates to an existing contract to the appropriate processes/functions.

sE6.3 Activate/Archive Contract: The activities associated with activation or de-activation and archiving the contract. This may include updating statuses of information in document management systems or ERP systems. This activity may be triggered and performed by the document management system or ERP system based on parameters entered as part of sE6.2 Enter and Distribute Contract.

sE6.4 Review Contractual Performance: The activities associated with reviewing the performance of contractual parties (both supplier and customer). This includes comparing the contractual service level agreements with the actual service levels. This process may be triggered by a calendar event - such as annual or quarterly quality reviews or actual performance issues identified in daily supply chain processes.

sE6.5 Identify Performance Issues/Opportunities: The activities associated with identifying and prioritization of key performance issues or areas of ongoing process improvement. This includes notifying contractual partners of non-conformance to contractual agreements or agreed service level agreements. This process addresses both the noncompliance issues (severe) as well as areas of continuous improvement (non-severe, common interest).

sE6.6 Identify Resolutions/Improvements: The activities associated with identifying ways to address the non-compliance or how to implement performance improvements. For non-compliance this process may have one or a combination of outcomes:

- Terminate the contract
- Pay/Collect Penalties
- Update contract (service levels, quality levels, terms and conditions)
- Continue as-is (internal process, policy or business rule changes)

Litigation or mediation may be considered in this process. Litigation or mediation is not part of supply chain processes.

sE6.7 Select, Prioritize and Distribute Resolutions: The activities associated with selecting, obtaining approvals and prioritizing the appropriate issue resolution and distributing the resolution to the appropriate processes/functions. Litigation or mediation may be the result of decisions made in this process. Litigation or mediation is not part of supply chain processes.

A.23 sE7 Manage Supply Chain Network

The process of developing, governing and maintaining a network of supply chain assets (locations, plants, buildings, equipment, people and processes) that support the planning, sourcing, making, delivery and returning of services in support of the business objectives and supply chain goals.

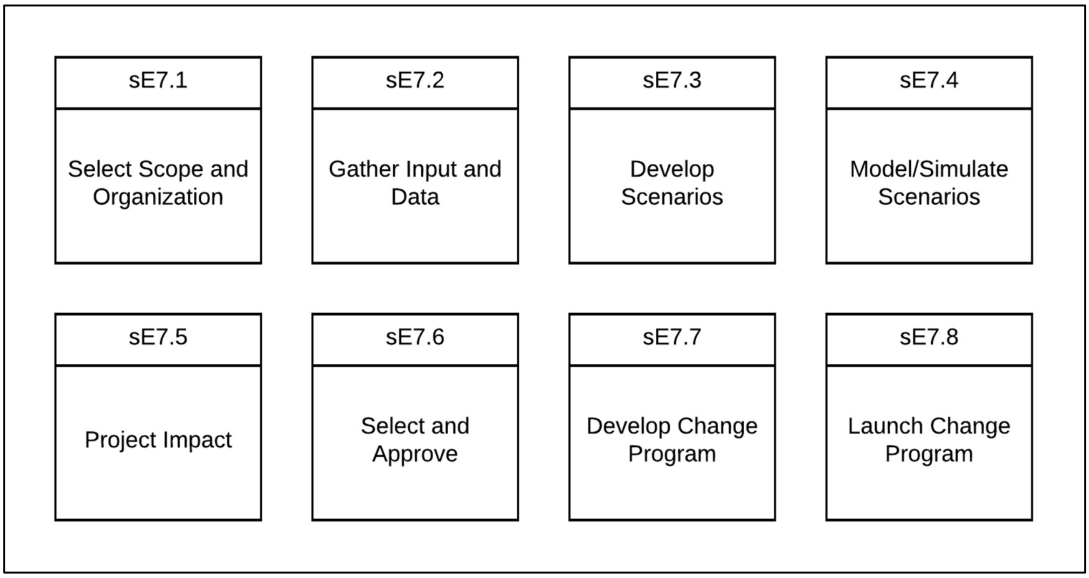

Figure 48: sE7 Manage Supply Chain Network

Hierarchy

sE7.1 Select Scope and Organization: The activities associated with determining what part of the supply chain network will be assessed (the scope). Organizations that manage the supply chain network as a project structure will need to establish a project organization. Organization selection includes identification and securing availability of sponsor, stakeholders and data/information providers as well as selecting project team members

sE7.2 Gather Input and Data: The activities associated with identification of the objective of the supply chain ('what strategy does the supply chain need to support') and collection of data required to describe (model) the supply chain at the required level. Data collected includes: facilities costs, capacity and locations, transportation cost, capacity and lead times, customer volumes, order frequency and size and customer locations.

sE7.3 Develop Scenarios: The activities associated with the development of scenarios (what-if) in support of different strategies and projections. Scenarios may be developed for different detailed strategies, requirements and potential internal/external changes. Activities include management interview, external transportation and warehousing studies. Initial review of developed scenarios may result in rejection of the scenario or proceeding to simulation.

sE7.4 Model/Simulate Scenarios: The activities associated with the development of models and/or simulation models to run 'what-if' scenarios through a validation process. Simulation models may use automation, but conference room pilots or walk-throughs may also serve this purpose. The purpose of simulation is to validate feasibility of each scenario and find possible network/process design flaws. Automated simulation tools may also predict the performance of the new network/processes by simulating the processing of large numbers of orders.

sE7.5 Project Impact: The activities associated with estimating the effort, risks, results of implementing the scenario. Effort includes the estimating the risks and duration and the funding, staffing and skills required for implementing the scenario. Risks include estimating the impact on the Value-at-Risk for the supply chain. Results include determining the changes to the performance of the supply chain on all relevant metrics.

sE7.6 Select and Approve: The activities associated with recommending and obtaining approvals for proposed supply chain network/configuration changes. This includes reviewing the 'what-if' scenarios and impact/benefit results with key stakeholders. The objective of this process is to identify the optimal solution and present this recommendation to sponsor and stakeholders and obtain approval to develop network change program.

sE7.7 Develop Change Program: The activities associated with developing the roadmap for change. This includes identifying the steps (or projects) required to implement changes to facilities, contracted parties, staffing, automation and process. Specific changes are assigned to unique owners. This includes reviewing the specific change/projects with key stakeholders. The objective of this process is to obtain approval to launch change projects.

sE7.8 Launch Change Program: The activities associated with coordinating, starting and monitoring the individual change projects. This includes support the establishment of change projects, coordinate launch dates and communicate reporting requirements. Steps may include archiving the supply chain network/ configuration project documentation for future reference and dissolving the project team. Dissolving the project team requires transfer of responsibilities to monitor progress to appropriate organizations.

A.24 sE8 Manage Regulatory Compliance

The process of identifying, collecting, assessing and integrating regulatory compliance requirements in standard supply chain processes, policies and business rules. Regulatory Compliance is the term generally used to describe the policies and processes which organizations have in place to ensure that they comply with laws, rules and regulations put in place by external bodies (government) which control activity in a given jurisdiction. A key component of Regulatory Compliance is establishing policies, business rules and processes to ensure legislative and regulatory compliance requirements are met. This includes ensuring personnel are aware of and take steps to comply with relevant laws and regulations and data or records retention used for compliance validation. Examples include: C-TPAT, Hazardous Materials, Import/ Export, Labour, Licensing, and Taxes. Note: These are examples; SCOR does not (attempt to) provide a complete list.

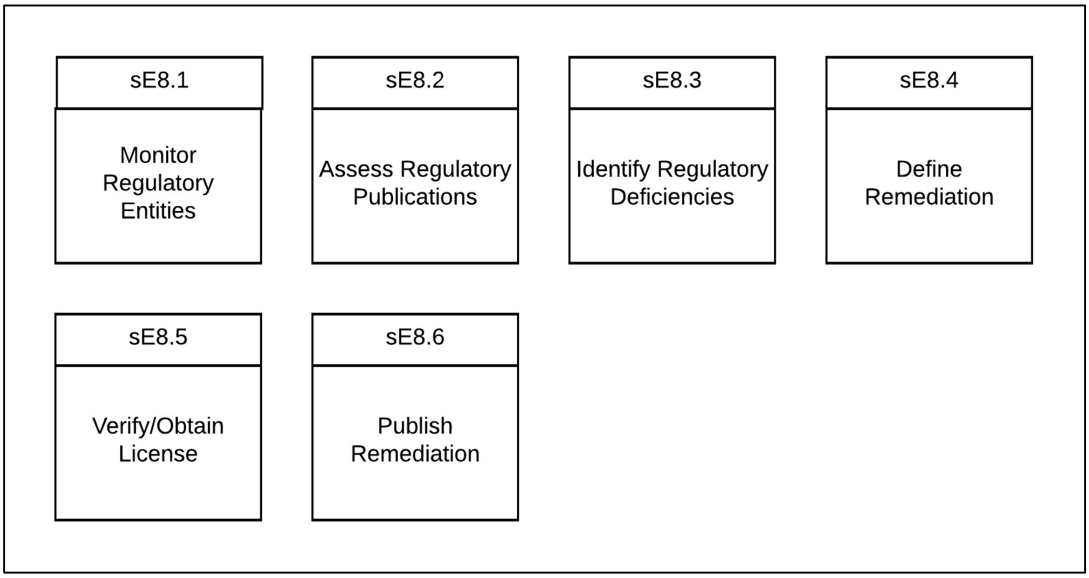

Figure 49: sE8 Manage Regulatory Compliance

Hierarchy

sE8.1 Monitor Regulatory Entities: The activities associated with identification regulatory publications, subscribing to publications, receiving and registering publications of relevant regulatory entities (e.g. government agencies).

sE8.2 Assess Regulatory Publications: The activities associated with reading, interpreting and researching policies, laws, rules and regulations. This includes determining if and how these regulatory requirements apply to the supply chain.

sE8.3 Identify Regulatory Deficiencies: The activities associated with identification of past, current and future regulatory requirements that are not or cannot be met using existing processes, business rules and policies. This includes notification of deficiency status to impacted organizations.

sE8.4 Define Remediation: The activities associated with identification remediation alternatives, selecting and documenting processes, policies and business rules and setting documentation requirements to remediate a deficiency.

sE8.5 Verify/Obtain License: The activities associated with verification of the remediation strategy with controlling entities and/or obtaining a license certifying compliance by the controlling entity.

sE8.6 Publish Remediation: The activities associated with approving and implementing changes to processes, policies and business rules. This may include distributing certification documentation to relevant organizations in the supply chain.

A.25 sE9 Manage Supply Chain Risk

The process of identification and assessment of potential disruptions (risks) in the supply chain and developing a plan to mitigate these threats to operating the supply chain. Supply chain risks include:

- Disruptions in demand - e.g. customers going out of business
- Disruptions in supply - e.g. suppliers going out of business, supplier quality/performance issues
- Environmental disruptions - e.g. weather, flooding, earthquakes
- Financial disruptions - e.g. availability of credit, investors
- Fraud, theft and mismanagement - lack of risk mitigation
- Labour disruption - e.g. employee strikes, availability of qualified staff
- Terrorism and cyber attacks

Risk mitigation strategies include avoiding the risk, reducing the impact or probability of the risk, transferring the risk to another party and accepting part of the risk. Example changes to the supply chain network, process and resources include: insurance, relocation, dual/triple sourcing, outsourcing, insourcing, offshoring, reshoring, security, supply chain redesign, process redesign, business rule changes, contract renegotiation.

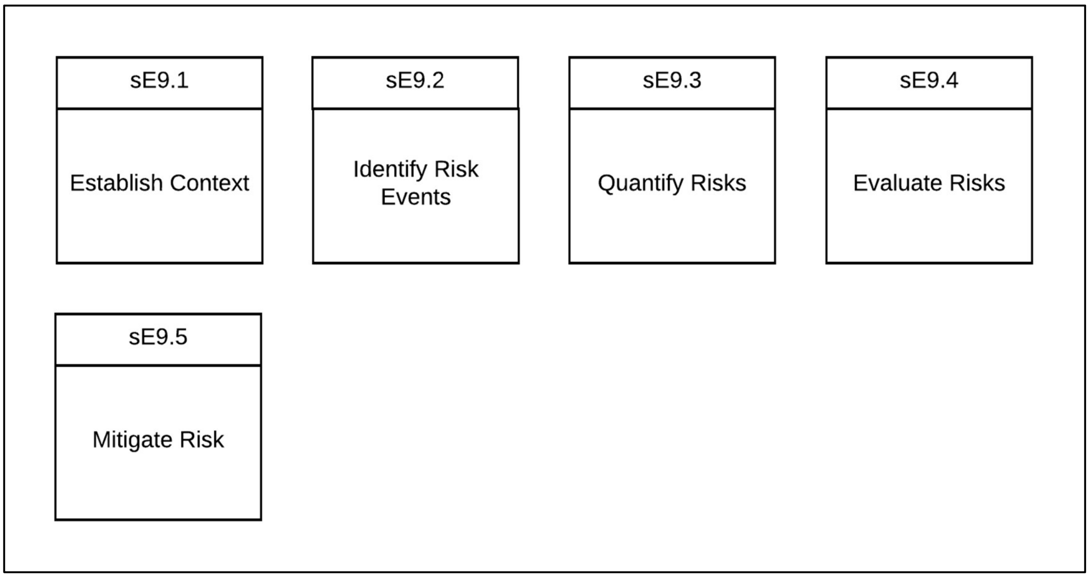

Figure 50: sE9 Manage Supply Chain Risk

Hierarchy

sE9.1 Establish Context: The process of defining and documenting the objectives and scope (internal and external) for managing risk. This includes developing/maintaining understanding of the internal and external relationships, internal and external factors that influence the supply chain's ability to achieve its objectives, and defining and maintaining a risk management organization -- stakeholders, governance structure, procedures and schedule.

sE9.2 Identify Risk Events: The process of identifying, collecting and documenting all potential risk events that may impact the organization from meeting its goals. This includes identification of sources of risks, identification and discovery of risk events.

This process generates a comprehensive list of all risks that may disrupt the supply chain, including information which processes in the supply chain will be directly and indirectly impacted by the occurrence of the risk event. A broad classification of risk types includes:

- Disruptions in demand - e.g. customers going out of business
- Disruptions in supply - e.g. suppliers going out of business, supplier quality/performance issues
- Environmental disruptions - e.g. weather, flooding, earthquakes
- Financial disruptions - e.g. availability of credit, investors
- Fraud, theft and mismanagement - lack of risk mitigation
- Labour disruption - e.g. employee strikes, availability of qualified staff
- Terrorism and cyber attacks

The number of risks within these types may differ by industry.

sE9.3 Quantify Risks: The process of collecting and documenting for each potential risk the causes, probability and consequences. The standard metric for quantification of risk is Value at Risk (VaR):

VaR = Probability of Occurrence x Monetary Impact of Occurrence

This process generates a comprehensive list of the monetary impact for all risks that may disrupt the supply chain. For certain types of risk events probability information may be available through government agencies, insurance companies or research firms. The monetary impact is determined based on the projected monetary impact for each supply chain for each risk event. For example:

- For a single sourced material, the supplier going out of business means the product manufactured using this material cannot be produced until a new supplier has been identified, qualified and integrated in the supply chain. The monetary impact would be the loss of the projected revenue for these products during the qualification and integration process of a new supplier.
- For a dual sourced material one of the two suppliers going out of business means the product manufactured using this material can only be produced for the percentage the remaining supplier may be able to support until a new supplier has been identified, qualified and integrated or until the remaining supplier can support 100% of the project revenue.

Different risk events may have different monetary impacts: reduction of revenue vs. increase of cost.

sE9.4 Evaluate Risks: The process of prioritizing risk events by VaR and determining for each risk whether mitigation actions are required or the risk is acceptable ('risk of doing business').

sE9.5 Mitigate Risk: The process of determining the actions required to eliminate, reduce or accept and monitor the risks - creating, approving, communicating and launching the 'Risk Mitigation Plan'.

A.26 AG.1.1 Upside Supply Chain Flexibility

The number of days required to achieve an unplanned sustainable 20% increase in quantities delivered.

Note - 20% is a number provided for benchmarking purposes. For some industries and some organizations 20% may be in some cases unobtainable or in others too conservative. The new operating level needs to be achieved without a significant increase of cost per unit. Component metrics (Upside Request Flexibility, Upside Fulfil Flexibility, etc.) can be improved in parallel and as a result, this calculation requires the result to be the least amount of time to achieve the desired result).

Calculation

Supply Chain Flexibility is the minimum time required to achieve the unplanned sustainable increase when considering Request, Fulfil, and Deliver components.

Total elapsed days between the occurrence of the unplanned event and the achievement of sustained plan, source, make, deliver and return performance. Note: Elapsed days are not necessarily the sum of days required for all activities as some may occur simultaneously. For example, if it requires 90 days achieve a 20% increase in raw material volume, 60 days for adding capital to support production, and no time to increase the ability to deliver, upside supply chain flexibility would be 90 days (if production changes can run concurrently with material acquisition activities) or as much as 150 days if production changes and material acquisition changes must run sequentially.

Data collection

Data for the components that are used to drive the calculation of supply chain flexibility are taken from the actual planning activities incurred in devising the actions to be taken and the execution activities themselves. Neither the complete set of activities nor any given subset of those activities can be identified except in either contingency plans (in which case they are hypothetical), special analytical simulations conducted for the purpose of predicting total elapsed time, or after the fact (when they have actually occurred and are unlikely to reoccur in the same combination). Flexibility measures are assumption based or based on historic events.

A.27 AG.2.1 Upside Request Flexibility

The number of days required to achieve an unplanned sustainable 20% increase in quantity of services supplied. Note: This is a planning activity normally considering constraints to increase delivery that results in an estimate.

A.28 AG.2.2 Upside Fulfil Flexibility

The number of days required to achieve an unplanned sustainable 20% increase in fulfilment with the assumption of no constraints on the supply of services to the service being considered.

Note: This is a planning activity normally considering constraints to increase delivery that results in an estimate.

A.29 AG.2.3 Upside Deliver Flexibility

The number of days required to achieve an unplanned sustainable 20% increase in quantity delivered with the assumption of no other constraints.

Note: This is a planning activity normally considering constraints to increase delivery that results in an estimate.

A.30 AG.1.2 Upside Supply Chain Adaptability

The maximum sustainable percentage increase in quantity delivered that can be achieved in 30 days.

Notes: 30 days is an arbitrary number provided for benchmarking purposes. For some industries and some organizations 30 days may be in some cases unobtainable or in others too conservative.

Calculation

Supply chain adaptability is the least quantity sustainable when considering Request, Fulfil and Deliver components.

Data collection

Adaptability measures are assumption based or based on historic events. Some elements can be measured and taken as a basis for further considerations. Adaptability measures are based on the actual number of returns compared to the maximum number of returns, which can be achieved within 30 days. The weakest component determines the overall volume.

A.31 AG.2.6 Upside Request Adaptability

The maximum sustainable percentage increase in sourced service quantities that can be acquired received in 30 days.

A.32 AG.2.7 Upside Fulfil Adaptability

The maximum sustainable percentage increase in service fulfilment capability that can be achieved in 30 days with the assumption of no service sourcing constraints.

A.33 AG.2.8 Upside Deliver Adaptability

The maximum sustainable percentage increase in quantities delivered that can be achieved in 30 days with the assumption of no other constraints.

A.34 AG.1.3 Downside Supply Chain Adaptability

The reduction in quantities ordered sustainable at 30 days prior to delivery with no cost penalties.

Note: 30 days is an arbitrary number provided for benchmarking purposes. For some industries and some organizations 30 days may be in some cases unobtainable or in others too conservative.

Calculation

Downside Source Adaptability + Downside Make Adaptability + Downside Deliver Adaptability Downside Supply Chain Adaptability is the least reduction sustainable when considering Source, Make, Deliver and Return components.

Data collection

Adaptability measures are assumption based on historic events. Some elements can be measured and taken as a basis for further considerations.

A.35 AG.2.11 Downside Request Adaptability

The services sourced quantity reduction sustainable at 30 days prior to delivery with no cost penalties.

A.36 AG.2.12 Downside Fulfil Adaptability

The source fulfilment reduction sustainable at 30 days prior to delivery with no cost penalties (note sustainable refers to can be afforded based on the utilisation of resources)

A.37 AG.2.13 Downside Deliver Adaptability

Downside Deliver Adaptability = The reduction in delivered quantities sustainable at 30 days prior to delivery with no cost penalties.

A.38 AG.1.4 Overall Value at Risk

Risk management in organizations traditionally resides within the finance function, due to its inherent focus on financial impact on the organization. However, most organizations do not assess the supply chain risk separately. In recent years, supply chain risk management (SCRM) has become the focus area for finance executives responsible for Enterprise Risk Management. Hence, there is a need to establish a common language to monetize the supply chain risk. Value at Risk (VaR) is a popular risk metric widely used by the finance industry to understand the risk exposure of a trading portfolio based on historic volatility.

A.39 Qualitative Relationship Description

The supply chain risk definition extends from supplier's supplier to customer's customer and the global environment they operate in. Hence, any event with a potential to disrupt linkages across the entire supply chain is considered as a Risk Event. Supply Chain Value at Risk – the sum of the probability of risk events times the monetary impact of the events that can impact any core supply chain functions (e.g. Plan, Request, Fulfil, Deliver and Return) or key dependencies.

Simple VaR calculation

VaR = Probability of Risk Event (P) x Monetized Impact of Risk Event (I)

Advanced VaR calculation

Applying more complex calculations, use of distributions and confidence intervals can attain more accurate measures of VaR.

Since VaR is an estimate, traditional estimating techniques of describing accuracy can also be used i.e. + or – 5%.

The use of VaR allows organizations to look at all potential supply chain risks through one metric and helps prioritize mitigation efforts. All the risk events across supply chain functions Plan, Request, Fulfil, Deliver, and Return can be rolled up to an overall VaR for the entire supply chain creating a financial lever to help integrate SCRM into the organization's overall risk management initiative.

Calculation

Supply Chain Risk VAR ($) = VAR $ (Plan) + VAR $ (Request) + VAR $ (Fulfil) + VAR $ (Deliver) + VAR $ (Return)

Data Collection

A risk event is categorized as any process failure (below target KPI) or disruption, which can adversely impact supply chain cost & performance. Following data are required for the simple VaR calculation:

- Probability of process failure – This should be calculated using historical data. Historical data of the specific process metrics (on time delivery, quality failures, supply delays, etc.) to calculate the number of times the event may perform below the target (probability). Also, the extent to which it is below the target when it fails.
- Probability of external risk event – Probability of disruptions like hurricane, earthquake can be derived through research data or expert opinions
- Risk Impact – This is a monetary estimate provided by the experts or business function specialist who can assess the repercussions of the risk event until normalcy is restored
- Applying the more complex VaR calculation with the use of distributions and confidence intervals can attain more accurate measures of VaR.

A.40 AM.1.1 Cash-To-Cash Cycle Time

This represents the time from the point where a company pays for the resources consumed in the performance of a service to the time that the company received payment from the customer for those services.

Calculation

Cash-To-Cash Cycle Time = [Inventory Days of Supply] + [Days Sales Outstanding] - [Days Payable Outstanding] in days.

Data collection

Unlike other SCOR metrics, where data requirements are specified, typically all of the cash-to-cash cycle time source data is already captured by business operating systems:

- General ledger system
- Accounts receivable system
- Accounts payable system
- Purchasing system
- Production reporting system
- Customer relationship management system

As a result, information is 'calculated' by importing data from these systems and transforming them into the prescribed analytics/information. The transformation is accomplished using business rules.

A.41 AM.1.2 Return on Supply Chain Fixed Assets

Return on Supply Chain Fixed Assets measures the return an organization receives on its invested capital in supply chain fixed assets. This includes the fixed assets used in Plan, Request, Fulfil, Deliver, and Return.

Calculation

Return on Supply Chain Fixed Assets = ([Supply Chain Revenue] – [Total Cost to Serve]) / [Supply-Chain Fixed Assets]

Data collection

Unlike other SCOR metrics, where data requirements are specified, typically all of the required source data is already captured by business operating systems:

- General ledger system
- Accounts receivable system
- Accounts payable system
- Purchasing system
- Production reporting system

- Customer relationship management system

As a result, information is 'calculated' by importing data from these systems and transforming them into the prescribed analytics/information. The transformation is accomplished using business rules. In order to measure Return on Supply Chain Fixed Assets, the investment in supply chain capital assets needs to be known. This requires a clear understanding of what is a "supply chain fixed asset". The SCOR sE5 process element is used since it is focused on managing supply chain capital assets. The value of these assets is the denominator of the metric.

A.42 AM.2.3 Days Payable Outstanding

The length of time from purchasing materials, labour and/or conversion resources until cash payments must be made expressed in days.

Calculation

[5 point rolling average of gross accounts payable (AP)] / [total gross annual service purchases / 365].

The '5 point rolling average' calculation uses a combination of both historical and forward-looking data. This means that the rolling average value has to be calculated based on the average over the four previous quarters and the projection for the current or next quarter.

A.43 AM.3.12 Deliver Return Cycle Time

The average time associated with returns.

A.44 CO.1.001 Total Cost to Serve

The sum of the supply chain cost to deliver services to customers. Total Cost to Serve includes the cost to plan the supply chain, cost to source materials, products, goods, merchandize and services, cost to deliver the requested service, cost to manage orders, and customer inquiries and returns.

Total Cost to Serve comprises of two types of cost:

- Direct cost. Cost that can be directly attributed to fulfilling customer orders. For example, the cost of purchased services, all direct supply chain labour, etc.
- Indirect cost. Cost required (or occurring) operating the supply chain. For example: Cost to lease and maintain equipment, stock depreciation, facilities costs, legal fees and contractual costs, etc.

Total Cost to Serve can be measured per event and at the aggregated supply chain level (assuming reporting capabilities exist). Measuring Cost to Serve at transactional level generally requires activity based costing capabilities for direct cost and a system to allocate indirect cost.

Calculation

Total Cost to Serve is the sum of:

- CO.2.001 Planning Cost
- CO.2.002 Request Cost
- CO.2.003 Service Acquisition Cost
- CO.2.004 Service Fulfilment Cost
- CO.2.005 Order Management Cost
- CO.2.007 Returns Cost

Unit of Measure: Total Cost to Serve is measured in monetary units.

A.45 CO.2.001 Planning Cost

The total cost of personnel, automation, and assets and overhead associated with supply chain planning processes. This includes activities associated with organizing, preparing, hosting and attending planning meetings, gathering and judging statistical demand data, gathering, aggregating and judging supply data, managing planning data and publishing plans.

Calculation

The sum of cost associated with supply chain planning processes. Planning Cost equals the sum of:

- Planning Labour Cost
- Planning Automation Cost
- Planning Property, Plant and Equipment Cost
- Planning Governance, Risk, Compliance (GRC) and Overhead Cost

Data collection:

Data is collected by identification, allocation and assigning relevant cost of planning process related departments or by identification of the cost of planning activities (e.g. Activity Based Costing). The following cost should be excluded:

- Cost associated with scheduling of customer orders, fulfilment orders, purchase orders and return authorizations, which are already included in Order Management Cost, Direct Make Labour Cost or Sourcing Cost.
- Other non-planning related costs that are included in cost metrics not listed above.

Unit of Measure

Planning Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO. 1.001 Total Cost to Serve.

A.46 CO.3.001 Planning Labour Cost

The costs associated with the personnel performing the tasks associated with supply and demand planning in support of operating the supply chain. This includes activities associated with organizing, preparing, hosting and attending planning meetings, gathering, aggregating and judging statistical demand data, gathering, aggregating and judging supply data, balancing supply and demand, managing planning data and publishing plans. Planning labour cost measures the labour directly associated with these activities.

Labour cost includes: wages, income taxes (federal, national, state, regional, local), and employer contributions to health insurance, social security and retirement plans.

Planning Labour Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO. 1.001 Total Cost to Serve.

A.47 CO.3.002 Planning Automation Cost

The costs associated with the automation (software, hardware, maintenance and consumable materials) of supply chain planning processes. Automation costs include acquisition, depreciation and disposition of hardware, licensing fees, cost of maintenance contracts, and labour cost of internal and/ or external automation maintenance and support staff.

If planning automation is (partially) outsourced, then Planning Automation Cost is the sum of the invoices from the outsourcing partners plus any additional internal automation cost incurred. Labour costs associated with automation are reported in Planning Automation Cost or alternatively Planning Labour Cost. Avoid double counting or omission of these labour costs.

Planning Automation Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.48 AM.1.3 Return on Working Capital

Return on working capital is a measurement that assesses the magnitude of investment relative to a company's working capital position versus the revenue generated from a supply chain.

Components include accounts receivable, accounts payable, inventory, supply chain revenue, cost of goods sold and supply chain management costs.

Calculation

Return on Working Capital = ([Supply Chain Revenue] – [Total Cost to Serve]) / ([Inventory] + [Accounts Receivable] – [Accounts Payable])

Data collection

Unlike other SCOR metrics, where data requirements are specified, typically all of the required source data is already captured by business operating systems:

- General ledger system
- Accounts receivable system
- Accounts payable system
- Purchasing system
- Production reporting system
- Customer relationship management system

As a result, information is 'calculated' by importing data from these systems and transforming them into the prescribed analytics/information. The transformation is accomplished using business rules.

Inventory may be applicable even though this is a service. A typical example may be the repair process.

A.49 CO.3.003 Planning Property, Plant and Equipment Cost

The costs associated with the (fixed) assets designated to support supply chain planning processes. PP&E costs include the cost of leases, rents, acquisition, depreciation, maintenance and disposition of land, buildings and equipment and labour cost and expenses of internal and/or external maintenance and support staff.

Cost of automation equipment is excluded from Planning PP&E Cost as these costs are reported as Planning Automation Cost. Labour costs associated with PP&E are reported in Planning Property, Plant and Equipment Cost or alternatively Planning Labour Cost. Avoid double counting or omission of these labour costs.

Planning Property, Plant and Equipment Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO. 1.001 Total Cost to Serve.

A.50 CO.3.004 Planning GRC and Overhead Cost

The governance, risk management, compliance and overhead costs allocated to supply chain planning processes. This may include cost of supporting organizations, e.g. Human Resources department, Legal department, Quality department, as well as office supplies and other indirect cost Example costs include:

- Quality management cost
- Risk mitigation costs
- Compliance remediation costs
- Process improvement costs
- Cost of Office supplies

Planning Governance, Risk, Compliance and Overhead Cost is measured in monetary units. For benchmarking purposes these costs may be reported as a percentage of CO. 1.001 Total Cost to Serve

A.51 CO.2.002 Request Cost

The total cost associated with managing the ordering, receiving, and inspection of services. These costs include labour costs for managing service acquisition, managing supplier performance, and purchase order management, inspection and sourcing overhead such as automation, facilities and indirect materials.

Calculation

The sum of all cost associated with the management and execution of purchasing materials. Sourcing Cost equals the sum of:

- Request Labour Cost
- Request Automation Cost
- Request Property, Plant and Equipment Cost
- Request Governance, Risk, Compliance (GRC) and Overhead Cost

Data collection

Data is collected by identification of relevant cost for each department or by activity (e.g. Activity Based Costing). The following cost should be excluded:

- The price paid for the services and arranging for the services to be delivered at the location of fulfilment
- Cost of identifying, qualifying and selecting suppliers (except for sS3: Engineer-to-order processes)
- Cost of negotiating pricing and conditions (except for sS3: Engineer-to-order processes)
- Cost of pre-processing the services, as these would be Fulfil related costs

Unit of Measure

Sourcing Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO. 1.001 Total Cost to Serve.

A.52 CO.3.005 Request Labour Cost

The labour costs associated with the personnel performing the ordering, and receiving purchased services. This includes activities associated with maintaining supplier data, processing payment, requesting and reviewing quotations, creating, changing and deleting purchase orders, scheduling and delivery, and requesting and providing status updates and approving payment of invoices. Sourcing labour cost measures the labour directly associated with these activities.

Labour cost includes: wages, income taxes (federal, national, state, regional, local), and employer contributions to health insurance, social security and retirement plans.

Request Labour Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.53 CO.3.006 Request Automation Cost

The costs associated with the automation (software, hardware, maintenance and consumable materials) in support of the acquisition of services. Automation costs include acquisition, depreciation and disposition of hardware, licensing fees, cost of maintenance contracts, labour cost of internal automation maintenance and support staff.

If request automation is (partially) outsourced, then Request Automation Cost is the sum of the invoices from the outsourcing partners plus any additional internal automation cost incurred. Labour costs associated with automation are reported in Request Automation Cost or alternatively Sourcing Labour Cost. Avoid double counting or omission of these labour costs.

Request Automation Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.54 CO.3.007 Request Property, Plant and Equipment Cost

The costs associated with the (fixed) assets designated to support the acquisition of services. PP&E costs include the cost of leases, rents, acquisition, depreciation, maintenance and disposition of land, buildings and equipment and labour cost and expenses of internal and/or external maintenance and support staff.

Cost of automation equipment is excluded from PP&E Cost as these costs are reported as Request Automation Cost. Labour costs associated with PP&E are reported in Request Property, Plant and Equipment Cost or alternatively Sourcing Labour Cost. Avoid double counting or omission of these labour costs.

Request Property, Plant and Equipment Cost are measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO. 1.001 Total Cost to Serve.

A.55 CO.3.008 Request GRC, Inventory and Overhead Cost

The governance, risk management, compliance, inventory and overhead costs allocated to acquisition processes (the ordering, receiving, inspecting, and processing and of purchased services). This may include cost of supporting organizations, e.g. Human Resources department, Legal department, Quality department, as well as office supplies and other indirect cost. Example costs include:

- Quality management cost
- Inventory depreciation
- Risk mitigation costs
- Compliance remediation costs
- Process improvement costs
- Costs of office supplies

Request Governance. Risk, Compliance, Inventory and Overhead Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO. 1.001 Total Cost to Serve.

A.56 CO.2.003 Service Acquisition Cost

The total cost associated with buying and delivering the service to the location of delivery. These costs include the purchase price (net of any discounts), travel costs, insurance and other cost -such as import/export duties, tariffs and other taxes associated with sourcing and delivery of the service to the location of delivery.

Calculation

The sum of the cost (actual price and expenses paid) to deliver services to the location of delivery, expressed in monetary units:

- Purchased Service Cost
- Service Transportation Cost
- Service Customs, Duties, Taxes and Tariffs Cost
- Service Risk and Compliance Cost

Data collection: Data is collected from (direct) service purchases paid or accrued. The following costs should be excluded:

- Cost of managing purchase requisitions and purchase orders, scheduling delivery and processing supplier invoices
- Cost of identifying, qualifying and selecting suppliers
- Cost of negotiating pricing and conditions
- Cost of receipt, pre-processing, and inspecting the material

Unit of Measure

Material Landed Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO. 1.001 Total Cost to Serve

A.57 CO.3.009 Purchased Service Cost

The total cost of the services purchased to produce the final service. Purchased Service Cost is reported at purchase price net of any discounts. Any additional cost paid (not included in the purchase price) are excluded from Purchased Service Cost - See Transportation Cost, Customs and Duties and Risk and Compliance Cost.

Purchased Materials Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.58 CO.3.010 Service Transportation Cost

The service transportation costs relate to all costs associated with ensuring that the services can be fulfilled at the point of delivery. This may include travel costs because services need to be completed as a joint collaboration and team, costs associated that the services can be executed remotely or costs associated to the service being performed at the location of a specific asset.

A.59 CO.3.011 Service Customs, Duties, Taxes and Tariffs Cost

The costs of import/export duties, taxes and tariffs, including the costs of third party services enabling customs clearance. Internal personnel cost related to customs and duties are reported in the Request Cost and should therefore not be reported in the Service Customs, Duties, Taxes and Duties Cost.

Service Customs, Duties, Taxes and Duties Cost is reported in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.60 CO.3.012 Service Risk and Compliance Cost

The risk and compliance costs associated with acquiring services. Example costs included in Service Risk and Compliance Cost are:

- Cost of Non Delivery (penalties)
- Cost of Damages (including consequential damages)
- Cost of mitigation of potential risk of supply disruption
- Cost of compliance to Health, Safety and Environmental legislation

Service Risk and Compliance Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.61 CO.2.004 Fulfilment Cost

The total cost associated with managing and performing the processes to fulfil the service, including scheduling service activities, performing activities on the service, performing diagnostics, and testing. Fulfilment can be partially or fully outsourced, Fulfilment Cost can therefore include fees paid to a third party manufacturer, fees for temporary labour and permanent staff.

Calculation

The sum of costs for labour, rent/Lease of facilities, equipment, automation, powering production locations and equipment for the production of services. Production Cost equals the sum of:

- Fulfilment (Direct) Labour Cost
- Fulfilment Automation Cost

- Fulfilment Property, Plant and Equipment Cost
- Fulfilment Governance, Risk, Compliance (GRC), Inventory and Overhead Cost

Data collection

Data is collected by identification, allocation and assigning relevant cost of production (Fulfil) process related departments or by identification of the cost of production activities (e.g. Activity Based Costing).

Unit of Measure

Fulfilment Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of C0.1.001 Total Cost to Serve.

A.62 CO.3.014 Fulfilment (Direct) Labour Cost

The total cost associated with the personnel performing the activities of Fulfil. This includes activities associated with scheduling service activities, pre-processing, and inspection and managing fulfilment data. Direct labour refers to the personnel that perform activities that can be directly attributed to fulfilling the service delivered.

Labour cost includes: wages, income taxes (federal, national, state, regional, local), and employer contributions to health insurance, social security and retirement plans.

Calculation

The sum of all cost associated with the activities to produce products.

Data collection

Data is collected by identification, allocation and assigning relevant cost of service process related departments or by identification of the cost of service activities (Activity Based Costing). The following cost should be excluded:

- Manufacturing overhead, such as cost of facilities and equipment, warehousing cost, (customer) order management cost
- Indirect labour cost, such as Human Resources, Finance
- Labour Cost of third party service providers

Unit of Measure

Fulfilment (Direct) Labour Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.63 CO.3.015 Fulfilment Automation Cost

The costs associated with the automation (software, hardware, maintenance and consumable materials) of fulfilment processes. Automation costs include acquisition, depreciation and disposition of hardware, licensing fees, cost of maintenance contracts, and labour cost of internal automation maintenance and support staff.

If fulfilment automation is (partially) outsourced, then Fulfilment Automation Cost is the sum of the invoices from the outsourcing partners plus any additional internal automation cost incurred. Labour costs associated with automation are reported in Fulfilment Automation Cost or alternatively Fulfilment (Direct) Labour Cost. Avoid double counting or omission of these labour costs.

Unit of Measure

Fulfilment Automation Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.64 CO.3.016 Fulfilment Property, Plant and Equipment Cost

The costs associated with the assets designated to support the fulfilment. PP&E costs include the cost of leases, rents, acquisition, depreciation, maintenance and disposition of land, buildings and equipment and labour cost and expenses of internal maintenance and support staff.

Cost of fulfilment automation equipment is excluded from Planning PP&E Cost as these costs are reported as Fulfilment Automation Cost. Labour costs associated with PP&E are reported in Production Property, Plant and Equipment Cost or alternatively Fulfilment Labour Cost. Avoid double counting or omission of these labour costs.

Production Property, Plant and Equipment Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of C0.1.001 Total Cost to Serve.

A.65 CO.3.017 Fulfilment GRC, Inventory and Overhead Cost

The governance, risk management, compliance, inventory and overhead costs allocated to the fulfilment. This may include cost of supporting organizations, e.g. Human Resources department, Legal department, Quality department, as well as office supplies and other indirect cost. Example costs include:

- Quality management cost
- Inventory depreciation
- Risk mitigation costs
- Compliance remediation costs
- Process improvement costs
- Costs of office supplies

Production Governance, Risk, Compliance, Inventory and Overhead Cost is measured in monetary, units for benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.66 CO.2.005 Order Management Cost

The total cost of personnel, automation and assets associated with responding to inquiries and quotes, order entry and maintenance, scheduling executing, order tracking and invoicing. This may include the cost of managing customer credit and collections.

Calculation

The sum of cost associated with managing customer data, entry, maintenance, scheduling, prioritization and expedition of customer orders, invoicing and collections. Order Management Cost equals the sum of:

- Order Management Labour Cost
- Order Management Automation Cost
- Order Management Property, Plant and Equipment Cost
- Order Management Governance, Risk, Compliance (GRC) and Overhead Cost

Data collection

Data is collected by identification, allocation and assigning relevant cost of order management related departments or by identification of the cost of order management activities (e.g. Activity Based Costing).

Unit of Measure

Planning Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost to Serve.

A.67 CO.3.018 Order Management Labour Cost

The costs associated with the personnel performing the order management tasks of customer order entry, maintenance and scheduling of delivery. This includes activities associated with maintaining customer data, processing payment, credit verification, responding to requests for services and quotations, creating, changing and deleting customer orders, scheduling delivery, providing status updates and issuing invoices. Order management labour cost measures the labour directly associated with these activities.

Labour cost includes: wages, income taxes (federal, national, state, regional, local), and employer contributions to health insurance, social security and retirement plans.

Order Management Labour Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO. 1.001 Total Cost to Serve.

A.68 CO.3.019 Order Management Automation Cost

The costs associated with the automation (software, hardware, maintenance and consumable materials) of order management processes. Automation costs include acquisition, depreciation and disposition of hardware, licensing fees, cost of maintenance contracts, and labour cost of internal and/or external automation maintenance and support staff.

If order management automation is (partially) outsourced, then Order Management Automation Cost is the sum of the invoices from the outsourcing partners plus any additional internal automation cost incurred. Labour costs associated with automation are reported in Order Management Automation Cost or alternatively Order Management Labour Cost. Avoid double counting or omission of these labour costs.

Order Management Automation Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of C0.1.001 Total Cost to Serve.

A.69 CO.3.020 Order Management Property, Plant and Equipment Cost

The costs associated with the (fixed) assets designated to support order management processes. PP&E costs include the cost of leases, rents, acquisition, depreciation, maintenance and disposition of land, buildings and equipment and labour cost and expenses of internal and/or external maintenance and support staff.

Cost of automation equipment is excluded from Order Management PP&E Cost as these costs are reported as Order Management Automation Cost. Labour costs associated with PP&E are reported in Order Management Property, Plant and Equipment Cost or alternatively Order Management Labour Cost. Avoid double counting or omission of these labour costs.

Order Management Property, Plant and Equipment Cost is measured in monetary units for benchmark purposes these costs may be reported as a percentage of C0.1.001 Total Cost to Serve.

A.70 CO.3.021 Order Management GRC and Overhead Cost

The governance, risk management, compliance and overhead costs allocated to order management processes (managing customer data, entry, maintenance, scheduling, prioritization and expedition of customer orders, invoicing and collections). This may include cost of supporting organizations, e.g.

Human Resources department, Legal department, Quality department, as well as office supplies and other indirect cost. Example costs include:

- Quality management cost
- Cost of office supplies
- Risk mitigation costs
- Compliance remediation costs

- Process improvement costs
- Costs of office supplies

Order Management Governance, Risk, Compliance and Overhead Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of CO.1.001 Total Cost

A.71 CO.2.007 Returns Cost

The total cost of disposition of services returned due to planning errors, supplier quality, and order management and delivery errors. These costs can be described as the cost to 'rework' an imperfect delivery to the customer. For Defective Returns and Excess Returns the purpose of this metric is to report the additional cost of 'fixing' an imperfect delivery.

Calculation

The sum of the costs related to the return processes

- Costs associated with managing the return processes
- CO.3.030 Return Governance, Risk, Compliance (GRC), Inventory and Overhead Cost

Data collection

Data is collected by identification, allocation and assigning relevant cost of disposition, discounts and refunds to products and services returned. The following costs should be

- (Returns) Order Management Labour Cost
- (Returns) Automation Cost
- (Returns) Property Plant and Equipment Cost
- (Returns) Customs, Duties and Taxes Cost
- (Returns) Governance, Risk, Compliance,
- (Returns) Production Costs

Unit of Measure

Return Cost is measured in monetary units. For benchmarking purposes these costs may be reported as a percentage of C0.1.001 Total Cost to Serve.

A.72 CO.3.030 Return GRC, Inventory and Overhead Cost

The governance, risk management, compliance, inventory and overhead costs allocated to returns processes. This may include cost of supporting organizations, e.g. Human Resources department, Legal department, Quality department, as well as office supplies and other indirect cost. These costs are primarily related to the decision-making processes. Example costs include:

- Inventory carrying cost - such as depreciation, shrinkage, theft
- Risk mitigation cost - such as insurance

- Compliance cost - local, national and international
- Quality management cost
- Process improvement cost
- Costs of office supplies

Return Governance, Risk, Compliance, Inventory and Overhead Cost is measured in monetary units. For benchmark purposes these costs may be reported as a percentage of C0.1.001 Total Cost

Cost of goods sold has been deprecated but it is also less relevant as there are many measures already covering the cost of the services delivered.

A.73 RL.1.1 Perfect Order Fulfilment

The percentage of orders meeting delivery performance with complete and accurate documentation. Components include all items and quantities on-time using the customer's definition of on time, and documentation.

Calculation

[Total Perfect Orders] / [Total Number of Orders] x 100%

Note, an Order is Perfect if the individual line items making up that order are all perfect.

The Perfect Order Fulfilment calculation is based on the performance of each Level 2 component of the order line to be calculated (service & quantity, date & time & Customer, documentation and condition). For an order line to be perfect, all of the individual components must be perfect.

- An order is considered perfect if the services ordered are the services provided and the quantities ordered match the quantities provided (% In Full).
- A delivery is considered perfect if the location, specified customer entity and delivery time ordered is met upon receipt (Delivery Performance to Customer Commit Date).
- Documentation supporting the order line is considered perfect if it is all accurate, complete, and on time (Accurate Documentation).
- The service condition is considered perfect if the service is delivered (as applicable) on specification, with the correct configuration, customer ready, and is accepted by the customer (Perfect Condition)

The calculation of line item perfect order line fulfilment is based on the Level 2 components:

- Each component receives a score of 1 if it is judged to be perfect.
- It receives a score of 0 if not perfect.

If the sum of the scores equal the number of components (in this case, 4) the order line is perfectly fulfilled.

A.74 RS.1.1 Order Fulfilment Cycle Time

The average cycle time consistently achieved to fulfil customer orders. For each individual order, this cycle time starts from the order receipt and ends with customer acceptance of the order. Time where the order could not be fulfilled because the customer was not ready or where the customers asked for the service to be delivered at a future date are excluded from the cycle time.

Calculation

[Sum Actual Cycle Times for All Orders Delivered] / [Total Number of Orders Delivered] in days

Data collection

Data for the components that are used to drive the calculation of responsiveness are taken from the Request, Fulfil and Deliver process elements.

A.75 RS.2.1 Request Cycle Time

The average time associated with Request Processes. (Processes: sR1, sR2, sR3)

Calculation

Request Cycle Time = (Identify Request of Supply Cycle Time + Select Supplier and Negotiate Cycle Time) + Schedule Service Deliveries Cycle Time + Verify Service Cycle + Authorize Supplier Payment Cycle Time

Discussion

Metrics in Level-3 that are used to drive the calculation of 'Source Cycle time' are taken from the Source process elements, depending on the possible strategies deployed by companies to fulfil orders such as make-to-stock, make-to-order or engineer-to-order. When make-to-stock or make-to order strategy is deployed, the dashed optional metrics 'Identify Sources of Supply Cycle Time' and 'Select Supplier and Negotiate Cycle Time' are not used in the calculation.

A.76 RS.2.2 Fulfil Cycle Time

The average time associated with Fulfil Processes

Calculation

Fulfil Cycle Time = Finalize Service Engineering (design) Cycle Time + Schedule Service Activities Cycle Time + Produce and Test Cycle Time + Package Cycle Time

Discussion

In Fulfil Cycle Time, there may be overlaps in the processes, so the "least amount of time" should be applied rather than the total sum.

A.77 RS.2.3 Deliver Cycle Time

The average time associated with Deliver Processes that is the time for the customer to accept the delivered service.

Appendix B
Case Study

B.1 Introduction

The SCOR model is a reference model that has been created to assist the user of the model to describe their supply chain, but also to improve their supply chain. The SCOR model is focused on the manufacturing industry although there is value for service organisations in understanding their service supply chains (Baltacioglu, Ada, Kaplan, Yurt and Kaplan, 2007). An adapted service SCOR model has been created to provide a reference model to users who would like to model services. The model is intended for services that can be regarded as standardised and delivered from a central back office.

This document provides a case study to illustrate the use of the adapted service SCOR model. In this case study, you have been assigned to form part of a team to investigate an IT service provider called WeRIT. WeRIT provides IT services to several large enterprises within South Africa. The IT service providers are under constant pressure to continually decrease their costs. This drive on cost reductions has been accelerated through the greater adoption of Cloud services within the IT market. WeRIT have always taken pride in the level of quality of their work and their ability to ensure high availability of their customers' IT systems. Recently this has also come under threat.

WeRIT have called you in to assist in improving their operations in two of their service supply chains. These service supply chains are their supply chains of End User Device Support and Server Support. The following section will give you an overview of the company as well as the various dimensions of the two service supply chains.

The flow and approach of this case study is based on the work of Weyers (1999) in providing a case study of modelling the supply chain for a manufacturing context. This is used as the input to creating a case study to model the supply chain for services.

The structure of this document will be to provide two service supply chains as part of an overall case study. The two case scenarios are very similar but have finer differences. The first scenario, that of tracking the service supply chain to provide end user device support is used to illustrate the various steps in analysing the supply chain. The second scenario, that of the service supply chain to support an IT (Information Technology) server is then provided for the reader to apply the techniques learned in considering the first scenario to the service supply chain of IT server support.

The case study will start by providing the two specific cases that will be considered. A short section follows this on the theory of the adapted service SCOR model. The document will then go through the various steps of analysis the service supply chains starting with mapping the overall supply chains, analysing the performance data of the overall supply chain, identifying the target performance data for the supply chain, associated the adapted performance data to the various role-players in the supply chain, identifying improvements that can be made to the supply chain and lastly mapping the adjusted supply chain.

The case study will also highlight features in the adapted service SCOR model even though they may not directly be used within the case study to provide the reader with the necessary tools to apply the model to its full extent beyond the scope of this case study.

In the next section, you will be requested to read through the case study and get an understanding of the company and how the services are performing. The reader should not be concerned about getting into the detail of the items just yet, as the details required will highlighted as the reader progresses through the various steps of the case study. The aim should be for the reader to become familiar with the two service supply chain scenarios and the challenges these supply chains face.

B.2 End User Device Support Process

This section will describe the first scenario that will be analysed. This is the process of supporting end user devices. The process of supporting end user IT devices is a service where desktop –, laptop computers or mobile devices are maintained and supported. The service is traditionally initiated by a request from the customer, but may also be a pro-active maintenance type function where a need to support the customer is driven by another event suggesting that activity or work is required on the user's device.

Support for end user devices is common practice but differs between the consumer and enterprise market. Consumers tend to support their own devices or take their devices to a computer retailer for assistance or repairs. In the enterprise business, enterprises take care of the support of the end user devices themselves as a service to their employees. This may be done by the enterprise themselves or may be done by external vendors to various degrees. Various parties may be involved in the process depending on the problem being experienced.

The service is part of a chain of services or service providers that together make up the overall service to the customer. For this example, the end user support supply chain is triggered by a customer initiating a call, referred to as an incident, to a centralised helpdesk or pro-actively through an event where maintenance teams detect the need for work to be done on the end users device (or requiring interaction with the end user).

Following this initiation of the incident, the helpdesk dealing with the call will at first try and resolve the incident. The helpdesk should be seen as a general function staffed by employees with a very general knowledge but with the primary function being the capturing of the end user incidents. Resolution is limited to highly structured events. From the helpdesk the end-user's calls will be routed to a number of functions depending on the specific content of the incident. For the purposes of this scenario we will focus on the incidents related to support of the end user device, so will only consider incidents related to this activity.

If the helpdesk is not able to adequately resolve the incident, the incident is routed to a team of support engineers that will attempt to resolve the incident remotely by taking control of the customer's device or guiding the customer to resolve the incident themselves.

If the incident cannot be resolved remotely, a field engineer is dispatched to the customer for resolution of the incident. If the problem is found to be one related to the hardware manufacturer, the field engineer may further require that the hardware vendor associated to the device repair the device, either at the premises of the end user or at the premises of the hardware vendor depending on the agreement with the hardware vendor.

B.2.1 Market

The market of end user device support is highly commoditised and increasingly so. Customers make their buying decision based on price. It has been the experience that customers express a desire for a differentiated service, but in the purchasing decision the primary decision factor is that of price.

Further to this, customers have an expectation that the price will drop by at least [redacted]% every year. This expectation is simply not achieved in the end user device support market due to the mature nature of the end user device support market. Actual experiences of [redacted]% year on year decreases have been experienced in the last 3 years.

The challenge in price decreases in the market is the high dependency on human intervention and the associated escalation in personnel salaries as living expenses increase. The IT service provider market has responded to this by increasingly dropping the skill level (and thus cost) of the engineers that attend to user calls.

The market measures the quality of the service based on the short turnaround time in getting their incidents resolved.

B.2.2 SWOT Analysis

Strengths

- [redacted]
- [redacted]

Weaknesses

- [redacted]
- [redacted]

Opportunities

- [redacted]
- [redacted]

Threats

- [redacted]
- [redacted]

Discussion

After analysing the Strengths, Weaknesses, Opportunities and Threats it is found that the market is continually trying to use technology to decrease the cost of delivering services. Also after investigating the quality issues with one of the service suppliers, it was found that the problems in quality was due to a lack of sufficient management controls and the drop in skilled resources due to the pressure in price.

B.2.3 Critical Success Factors

- Drop the cost of the End User Device Support charge
- Maintain the quality of the end user device support service to customers
- Be able to deliver on a growing base of new customers with new deals

B.2.4 Operational Performance

After analysing the environment, the following operational information was received.

The total tickets that were received and resolved by the respective areas are shown in Table 32

Table 32: Summary of Tickets Resolved

	Tickets Received	Tickets Resolved
Service Desk	[redacted]	[redacted]
Remote Support	[redacted]	[redacted]
Field Support	[redacted]	[redacted]
Hardware Support	[redacted]	[redacted]

The charge per device is show in Table 33.

Table 33: Charge per Device

	Charge per Device
Service Desk	[redacted]
Remote Support	[redacted]
Field Support	[redacted]
Hardware Support	[redacted]

An analysis of the costs associated to the devices and tickets are proved in Table 34.

Table 34: Analysis of Cost for End User Support

	Total Cost	Cost per Ticket	Cost per Ticket Resolved
Service Desk	[redacted]	[redacted]	[redacted]
Remote Support	[redacted]	[redacted]	[redacted]
Field Support	[redacted]	[redacted]	[redacted]
Hardware Support	[redacted]	[redacted]	[redacted]

Table 35 provides an analysis of the time associated in resolving the total tickets.

Table 35: Time Spend on End User Devices

	Time (hours)	Total Time	Avg Time to Resolve
Service Desk	[redacted]	[redacted]	
Remote Support	[redacted]	[redacted]	
Field Support	[redacted]	[redacted]	
Hardware Support	[redacted]	[redacted]	
		[redacted]	[redacted]

The total number of devices being supported is [redacted] devices.

The flexibility of the Supply Chain to increase capacity within 30 days, decrease capacity in 30 days and the number of days required to increase capacity by 20% is given in Table 36.

Table 36: Supply Chain Flexibility for End User Support

	20% Increase	Upside in 30 days	Downside in 30 days
Service Desk	[redacted]	[redacted]	[redacted]
Remote Support	[redacted]	[redacted]	[redacted]
Field Support	[redacted]	[redacted]	[redacted]
Hardware Support	[redacted]	[redacted]	[redacted]

The following should be noted as part of the operational views

1) A total of [redacted] tickets were received
2) A total of [redacted] tickets were resolved within the agreed timelines with the correct level of quality
3) A failure to meet the required Service Levels results in a penalty to the maximum of R[redacted] million per month. The probability of failing a service level is considered to be [redacted]% probability.
4) The company has no arrangements to pay suppliers in future. All costs are paid immediately as they are predominantly salaries
5) The company has an arrangement with customers that customers only have to pay after 90days after receiving an invoice.
6) The total cost of the service is R[redacted] per device
7) The total charge to the customer is R[redacted] per device
8) The fixed assets linked to the service is R[redacted] million

B.3 Server Support

The second scenario is that of IT server support. The process of supporting IT servers is a service where the tasks are completed to ensure that the IT server operating system is available for customer applications to run on these servers. The approach to IT server support is to perform

- Preventative and proactive activities to ensure the continued availability of the IT server operating system to the customer,
- Reactive steps to ensure or restore IT server availability in the case where the availability of the IT server is threatened (e.g. degraded performance), and
- On-going maintenance tasks to ensure that the operating system configuration on software versions are in line with the industry best practice or standard that may be otherwise defined.

The IT server support service is one typically required from enterprises with large server farms where the availability of their IT servers is critical for the operation of the business. The IT server support service is one that is contracted in advance with an inventory of IT servers to be supported. This may be done by the enterprise themselves or may be done by external vendors to various degrees. Various parties may be involved in the process depending on the problem being experienced.

The service is part of a chain of services or service providers that together make up the overall service to the customer. For this example, the IT server support supply chain is triggered by an automated event that gets generated after a threshold condition has been experienced by one of the servers being supported by the IT server support contract. Ensuring that the IT server is enabled to allow these automated events triggers this event. This event may then be automatically converted to a formal ticket, referred to as an incident, or it may be detected by a team of operators reviewing events that are generated by the IT servers who will then convert the detected event into the formal incident.

The operator team will then investigate the incident further and confirm the validity of the incident. If the incident is found to be valid the operator team will refer to the server support contract to establish if the server support contract has any special arrangements associated with the time to respond to the incident or the time within which the server may be worked on. The operator team will also establish the criticality of the server from the server contract information and accordingly associated a priority to the server incident.

From here the operator team will route the incident to the second level support teams. The operator team will further ensure that the second level support teams are made aware of the incident that has been created based on the priority of the incident that was generated.

The second level team will take the incident and resolve the incident as far as possible. The second level team are a team that can function across clients and across technologies. They may use automation toolsets to perform certain standardised functions and activities.

If the second level team are not able to resolve the problem or where the criticality of the IT server requires special attention, the level three team may be required to assist the level two teams in restoring the availability of the IT server.

The second or third level teams may also find that the problem lies beyond IT server support. An example of this may be that the ticket may require attention by a team of experts focusing on server virtualisation technologies. From here it may also be found that the physical IT server may have problems in which case the server hardware provider is called in to assist.

B.3.1 Market

The market of server support was initially treated as a very bespoke and specialised skill but has increasingly moved into the commodity space. It is difficult to compare service providers in what they deliver in the space. The current shift in pricing in the market is driven by a shift in the ratio of engineers to server support ratio.

Further to this, customers have an expectation that the price will drop by at least [redacted]% every year. This expectation is normally met if not exceeded. The rapid drop in server support charges is supported by a trend of customers becoming more accustomed to a standardised service with the greater acceptance of cloud-based services. Cloud based services have further encouraged rapid reductions in the expectations of supporting automation toolsets associated to the server support service.

The server support service is still predominantly centred around on premise server farms or localised platforms. The movement to cloud has resulted in customers requiring reduced support on the server Operating System if not a total reduction in the service.

The rate in price decreases poses a challenge to the server support market in keeping to the pace of the reduction in price as can be perceived in the rest of the market or that can be achieved from cloud services.

B.3.2 SWOT Analysis

Strengths

- [redacted]
- [redacted]
- [redacted]
- [redacted]

Weaknesses

- [redacted]
- [redacted]
- [redacted]
- [redacted]

Opportunities

- [redacted]
- [redacted]

Threats

- [redacted]
- [redacted]

Discussion

After analysing the Strengths, Weaknesses, Opportunities and Threats it is found that the market is being challenged by an unreasonably high rate of price reductions. WeRIT must be able to keep to current quality levels while maintaining the drop in price to remain competitive.

B.3.3 Critical Success Factors

- Decrease server support charge at rates more than [redacted]% per year
- Quantify the value provided as opposed to other service providers
- Provide a model that is capable of handling smaller clients at a same price point of large customers

B.3.4 Operational Performance

After analysing the environment, the following operational information was received.

The total tickets that were received and resolved by the respective areas are shown in Table 37.

Table 37: Summary of Tickets Resolved for Server Support

	Tickets Received	Tickets Resolved
Automation	[redacted]	[redacted]
Operators	[redacted]	[redacted]
Level 2	[redacted]	[redacted]
Level 3	[redacted]	[redacted]
Hardware Support	[redacted]	[redacted]

The charge per device is show in Table 38.

Table 38: Charge per Device Server Support

	Charge per Device
Automation	[redacted]
Operators	[redacted]
Level 2	[redacted]
Level 3	[redacted]
Hardware Support	[redacted]

An analysis of the costs associated to the devices and tickets are proved in Table 39.

Table 39: Analysis of Cost for Server Support

	Total Cost	Cost per Ticket	Cost per Ticket Resolved
Automation	[redacted]	[redacted]	[redacted]
Operators	[redacted]	[redacted]	[redacted]
Level 2	[redacted]	[redacted]	[redacted]
Level 3	[redacted]	[redacted]	[redacted]
Hardware Support	[redacted]	[redacted]	[redacted]

Table 40 provides an analysis of the time associated in resolving the total tickets.

Table 40: Time Spent on Server Support

	Time (hours)	Total Time	Avg Time to Resolve
Automation	[redacted]	[redacted]	
Operators	[redacted]	[redacted]	
Level 2	[redacted]	[redacted]	
Level 3	[redacted]	[redacted]	
Hardware Support	[redacted]	[redacted]	
		[redacted]	[redacted]

The total number of devices being supported is [redacted] devices.

The flexibility of the Supply Chain to increase capacity within 30 days, decrease capacity in 30 days and the number of days required to increase capacity by 20% is given in Table 41.

Table 41: Supply Chain Flexibility for Server Support

	20% Increase	Upside in 30 days	Downside in 30 days
Automation	[redacted]	[redacted]	[redacted]
Operators	[redacted]	[redacted]	[redacted]
Level 2	[redacted]	[redacted]	[redacted]
Level 3	[redacted]	[redacted]	[redacted]
Hardware Support	[redacted]	[redacted]	[redacted]

The following should be noted as part of the operational views

1) A total of [redacted]tickets were received
2) A total of [redacted]tickets were resolved within the agreed timelines with the correct level of quality
3) A failure to meet the required Service Levels results in a penalty to the maximum of R[redacted] thousand per month. The probability of failing a service level is considered to be [redacted]% probability.
4) The company agreed arrangements of [redacted] days to pay for automation and the hardware support.
5) The company has an arrangement with customers that customers only have to pay after [redacted] days after receiving an invoice.
6) The total cost of the service is R[redacted] per device
7) The total charge to the customer is R[redacted] per device
8) The fixed assets linked to the service is R[redacted] million
9) After investigations, it is found that the Automation Costs cannot be reduced in any way from the current charging based on the current volumes

B.4 SCOR Methodology Applied in Four Steps

As discusses in the Introduction, the facilitated walk-throughs will be completed following structured approach to the overall supply chain. The steps that will be taken will be:

1) Mapping the overall supply chains (Section B.5 and Section B.6),
2) Analysing the performance data of the overall supply chain (Section B.7),
3) Identifying the target performance data for the supply chain (Section B.8 and Section B.9),
4) Associate the adapted performance data to the various role-players in the supply chain (Section B.9 and Section B.10),
5) Identifying improvements that can be made to the supply chain (Section B.12) and
6) Lastly, mapping the adjusted supply chain (Section B.13).

This is then the order in which an implementation is done. The reader may progress to following steps without a previous step being completed. This is however discouraged.

Supply Chain Reference Models are used to simplify or give guidance when modelling a supply chain. Modelling any process or chain is possible with the simplest of techniques or with very mature and complex modelling methodologies. Supply chain reference models attempt to make it easier for users to model their supply chains and cover the essential items relevant for the supply chain. Modelling of supply chains can be time consuming and making mistakes can be easy. Supply Chain reference models are used to address the potential pitfalls in modelling supply chains. Reference models are conceptual models developed to be reused during the modelling process. Reference models can be reused by taking parts of one or more original models and adapting and extending them in the resulting model (Stein, Heddier, Knackstead and Becker, 2014). Figure 51 shows the components of the Operations Reference Model.

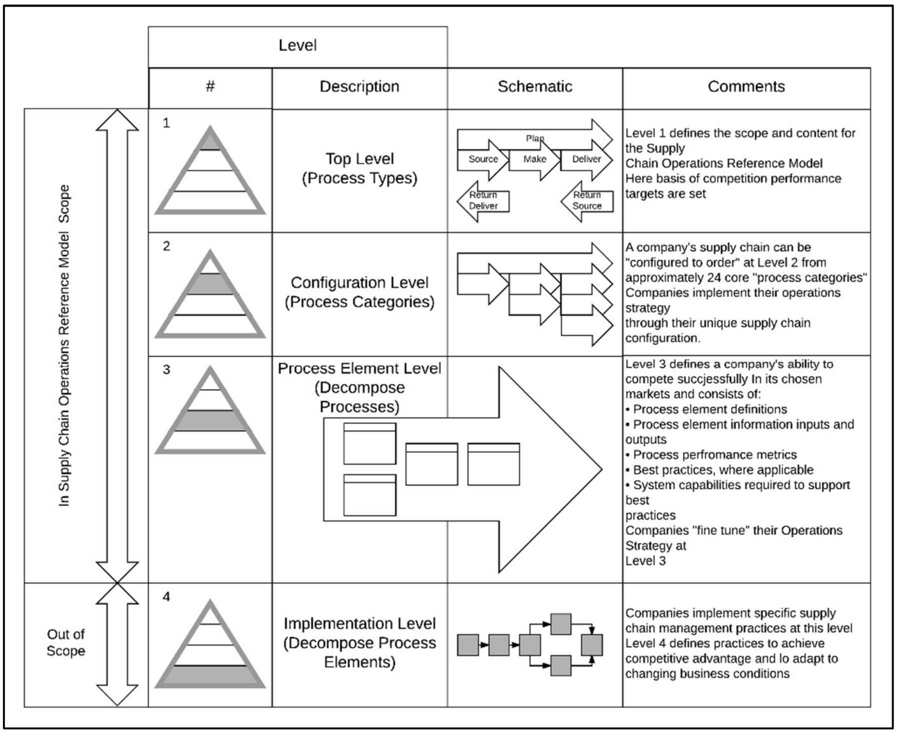

Figure 51: Supply Chain Operations Reference Model

The supply chain operations reference (SCOR) model is a strategic planning tool that allows senior managers to simplify the complexity of supply chain management. From this it can be deduced that one of the goals of the SCOR model is to simplify complex scenarios to make it easier for senior management to make decisions about their supply chain. Furthermore, the SCOR model is a diagnostic tool that assists managers to design and manage supply chain processes of an organisation at the strategic as well as operational level (Giannakis, 2011).

SCOR does not provide modelling tools to model each process in infinite detail. High-level building blocks are provided providing sufficient detail to understand the interdependencies between companies and the flow of information and goods between them. The approach to supply chain management is not to model all the detail but rather only the essential elements required to describe the supply chain. High-level processes like plan, source, make and deliver are measured through a small number of key KPIs to successfully manage and operate the supply chain (Sengupta, Heiser, and Cook, 2006).

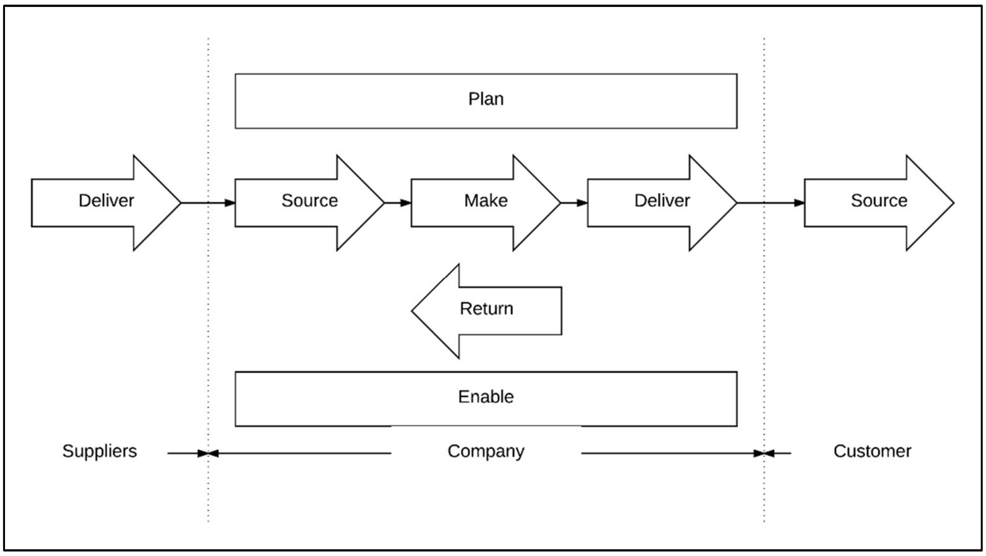

Figure 52: SCOR Processes

The SCOR model divides all the elements into either Plan, Source, Make, Deliver, Return and Enable (see Figure 52). This is for the SCOR model, as it is known in the manufacturing context. This SCOR model has been adapted for standardised back office services in an adapted service SCOR. This adapted service SCOR uses the concepts of Request, Fulfil and DELIVER.

Request contains all the processes that relate to requesting a service from other service providers in delivering a service to a customer.

Fulfil described all the work done to execute the service steps that the company is responsible for.

DELIVER describes all the effort related to receiving a request from a customer or a company contracting with the company delivering the service, and then delivering the service to the requesting company and ensuring that the work is delivered with the correct quality and time.

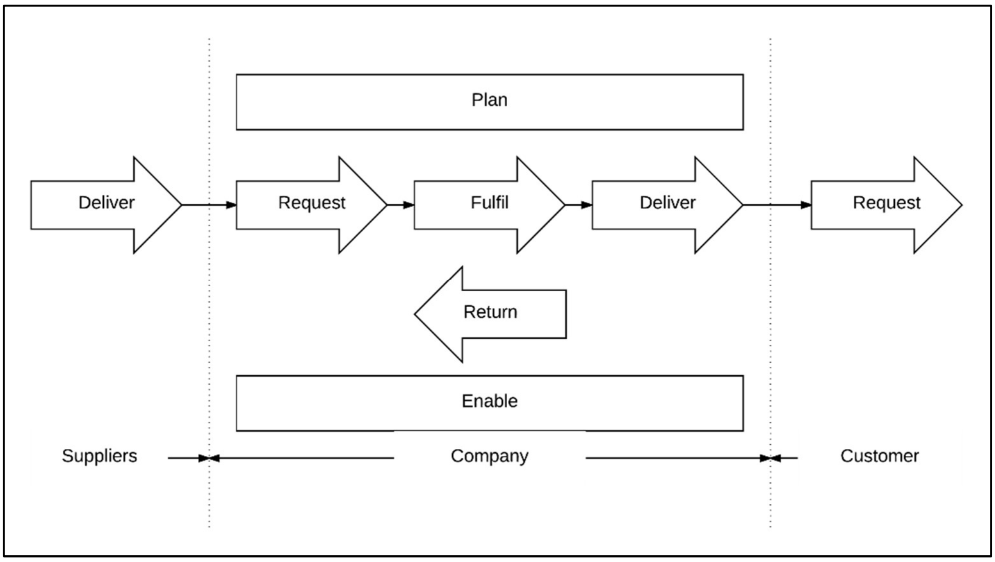

Figure 53: Adapted service SCOR

Each of these process categories are further categorised into sub categories referred to as the Level 2 process level. On this level the general distinction is drawn between:

1) Scheduled Service: a standard service that has been scheduled ahead of time allowing the supply chain to prepare and arrange capacity for the service,
2) Unscheduled Service: a service where the supply chain must respond immediately without prior warning, and
3) Engineered Service: a service that is custom designed for the specific user requirements.

A list of all the Level 2 processes is provided in Figure 55.

The SCOR model further has more elements than merely process. The SCOR model also describes Performance Metrics, Best Practices and Organizational Design. This case study will only illustrate the use of the process and performance indicator dimensions of the SCOR model.

The case study will illustrate the use of their process elements in the subsequent sections. The tutorial will consist out of discussions and then a point where the practitioner will be required to provide their solution. As the model builds upon decisions made in previous steps, the model will follow one trail of solutions. This is not to say that the solutions suggested by the practitioner are wrong, it is simply impossible to cater for all solutions. The practitioner is thus encouraged to provide their own solutions but continue with the tutorial using the solutions that have been suggested.

B.5 Kicking Off

The facilitated walk-throughs described the various services being delivered and also described the challenges associated with the service. From the case study, it should already be easy for the reader to identify areas that could be improved upon, but for now the focus is on going through the steps as highlighted in the previous section.

First the reader needs to consider what the Supply Chain is. Supply Chains are defined in one of two ways. The first and very obvious form of defining the Supply Chain is by considering the service and what is flowing in the service. Each service has its own flow and thus its own Supply Chain. The second method is by defining the Supply Chain in terms of the customer channels. It is a common practice to distinguish between various customers (e.g. premium customers vs. budget customers). Customers are not all equal in the way services are targeted at the customer. With this differentiation in mind, each customer group may require a different Supply Chain.

For this case study, we will choose the Supply Chains with regard to the service and what flows in the service. Here WeRIT has two services it is offering, and thus two Supply Chains.

The rest of the tutorial will be discussed by first using the End User Support service as an example. The reader will then be required to complete the task for the IT Server support service.

B.5.1 The As-Is Supply Chain for End User Device Support

The first step in modelling the supply chain is to plot the role-players in the chain and the general flow of the services through the chain. The goal is to use pictures or icons that are interesting and illustrate the various role-players. Lastly the service SCOR level 2 processes should be identified at each location and linked to each of the role-players in the supply chain.

The approach to modelling a supply chain using the adapted SCOR model is that it is assumed that each role-player in the chain performs three functions, these functions being Request, Fulfil and DELIVER. These process steps are written in upper case consistently through the document to highlight when the case study is referring to the process or simply using the word in its normal context. Each of these processes is marked with a sR, sF and sD respectively. A numeric number then follows the process notation to depict the different type of process being considered in the supply chain. A table of all the various process elements are provided in Figure 55. You may consult the adapted service SCOR glossary to get a more detailed description of the different process elements. In this case most of the process elements will have a notation of sX2 as the notation with 2 refers to unscheduled services.

To illustrate this use of the process notation, consider the processes at the remote support engineer. The remote support engineer will receive the ticket from the service desk. The ticket will be unscheduled service as it is based on when the client calls which is not predictable. The ticket may however be scheduled if the customer asked to be called back at a certain time but in general it will be as soon as the customer can be contacted. The logic to be applied is for the remote support engineer the task of completing work is listed under Fulfil, which means that the sF2 notation is valid. The process of DELIVER describes how the remote support engineer receives the request and then how the service is delivered back to whoever requested the service. In this case the previous role-player in the supply chain is the service desk. The service desk thus requests a service from the remote support engineer and the remote support engineer delivers the service to the service desk. This DELIVER process is thus an sD2 process as the service will be delivered toward the service desk and it is unscheduled. The remote support will attempt to fulfil the ticket themselves. If the remote support cannot deliver the service, the service will be requested from the on-site engineer. The process towards the on-site engineer is thus a sR2 as it will be unscheduled. In turn the on-site engineer will deliver their service toward the remote-support team.

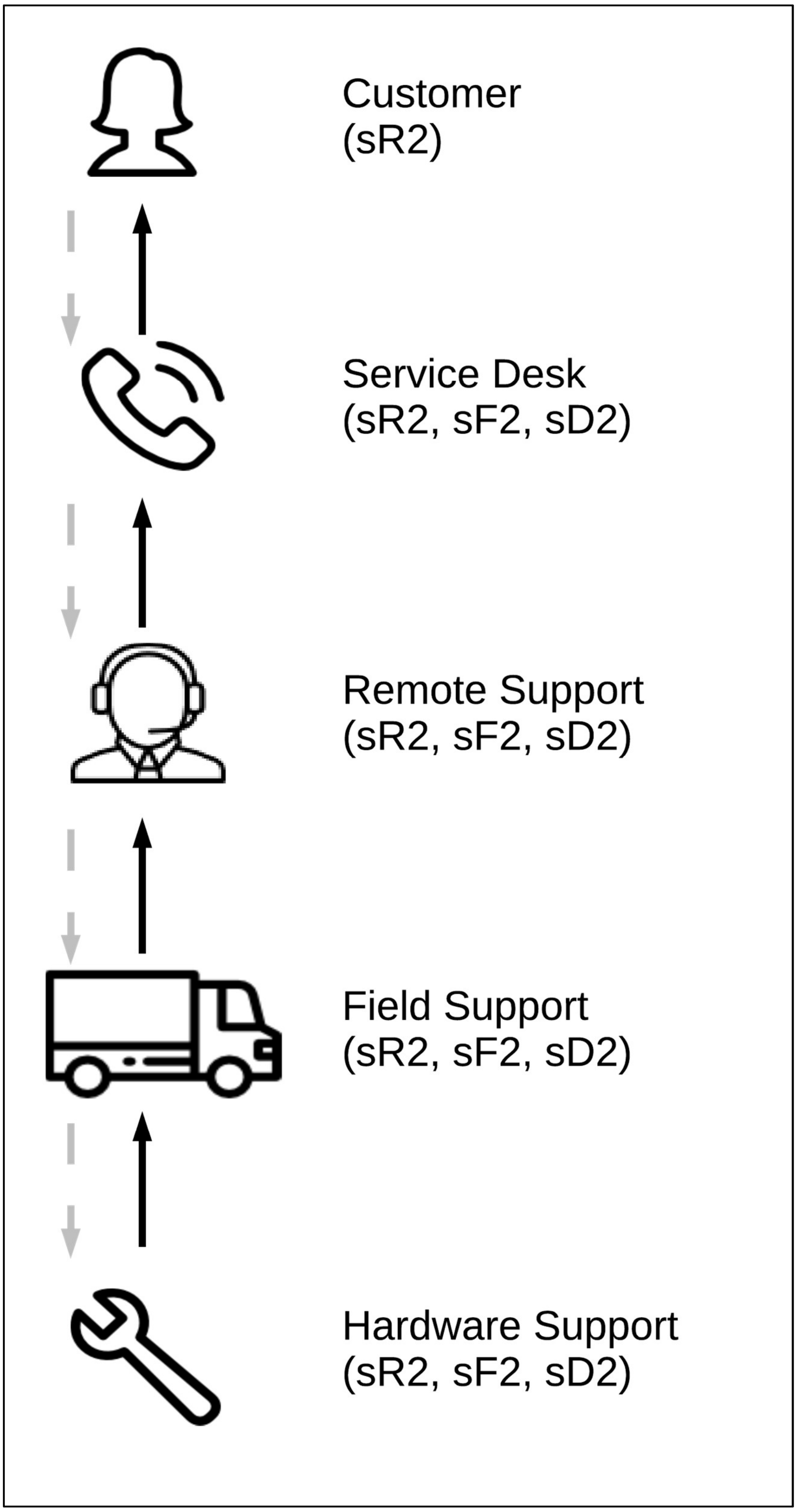

Figure 54: As-Is Supply Chain: End User Device

The mapping shown here usually gives rise to a number of questions. As mentioned, in some cases the service may be scheduled or unscheduled. It is debatable how the reader wants to implement this. As a general rule in this case study the process of support process will be based on an unscheduled service. In the case of a request to enhance a service or an additional service the process will most likely be a scheduled process. The use of a Request, Fulfil, DELIVER may be considered counter intuitive as the logic flow is actually DELIVER, Fulfil and Request with Request being used if a service is required higher up the supply chain. This approach is however taken as it shows the flow of the services when eventually being delivered toward the client. To address this, it is suggested to start the naming convention from the most final source back towards the customer in a Request, Fulfil and DELIVER fashion. Although the original flow is from the customer towards the original source, the logic is to model the delivery of the service from the most original source (or final role-player) towards the customer the service is being delivered to.

A list of the service SCOR processes can be found in the adapted service SCOR glossary along with their definitions. Figure 55 provides an overview of the various model elements available.

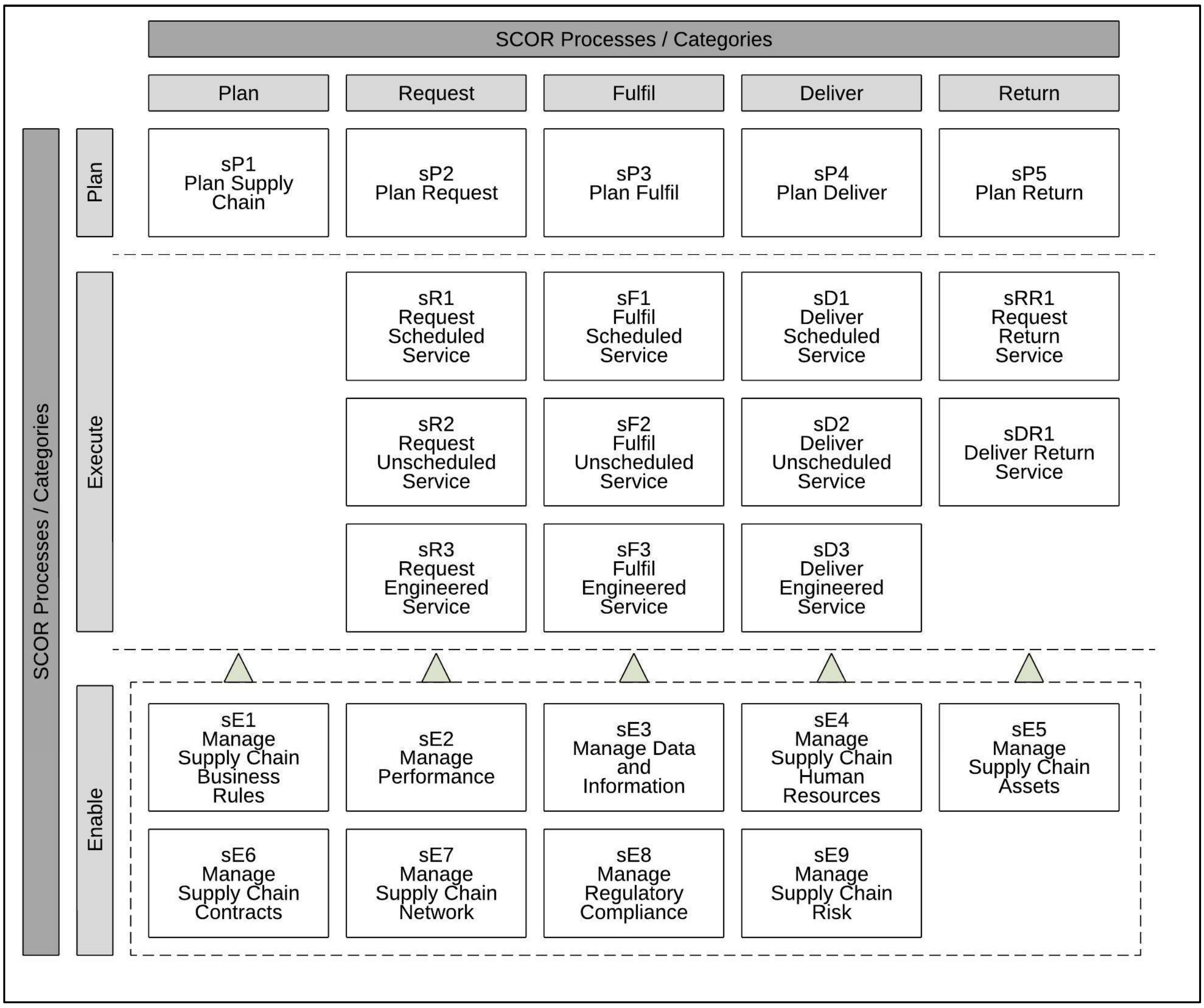

Figure 55: Process Elements

B.5.2 Exercise 1

Now complete the following steps for the IT Server Support service on the map provided below

1) Draw the actors associated with the service supply chain (in the provided template marked Figure 56)
2) Draw the flow of services between the various entities starting from the final source item towards the customer
3) Add the SCOR level two process identifiers (R1, F1, D1, etc.) to the actors

Note that you have no interest in showing the inter- and infra- company borders in this diagram, the idea is simply to draw the end-to-end Supply Chain in this step.

Figure 56: As Is Supply Chain: IT Server Support Template (frame left intentionally blank)

B.6 Configuring the Supply Chain

This section continues from the previous one where the various role-players were identified. Now that the reader has plotted the service supply chain it needs to be mapped into a diagram that better illustrates the sequential progression as the product flows through the chain.

In this mapping, each of the execution processes identified in the pictorial representation is drawn in a sequential order and represented witmanufacturing disciplih an arrow.

Figure 57 shows how these processes have been plotted. Now that the execution processes have been drawn, planning processes must be drawn for each of these processes. This is done by placing the planning processes for each of the execution level processes above the execution processes. Note that the planning process of the execution process is linked to the next process that follows.

Lastly a thread of planning processes is grouped with a sP1 process. Here a thread could be defined as the processes between and including a sequence of supply and demand processes.

A few interesting issues now arise when considering this. The first is the sP1 (PLAN 1) processes. These processes can also be used to group the sP1 processes of various threads. It is thus felt that the contents of the process are of such a nature that it actually encapsulates other sP1 processes. You may thus have a sP1 that describes one or more different companies which in turn cascades to their respective sP1 processes.

Another interesting point is that of a thread and the Request and DELIVER blocks. In theory, the ideal would be that the Request and DELIVER blocks become one between companies. Companies do not need to Request or DELIVER anymore; they are in fact a seamless or virtual organisation. This combination and Request and DELIVER are even more apparent in services than for manufacturing. Section B.11 will elaborate on the use of the Request and DELIVER processes, especially as they relate to services.

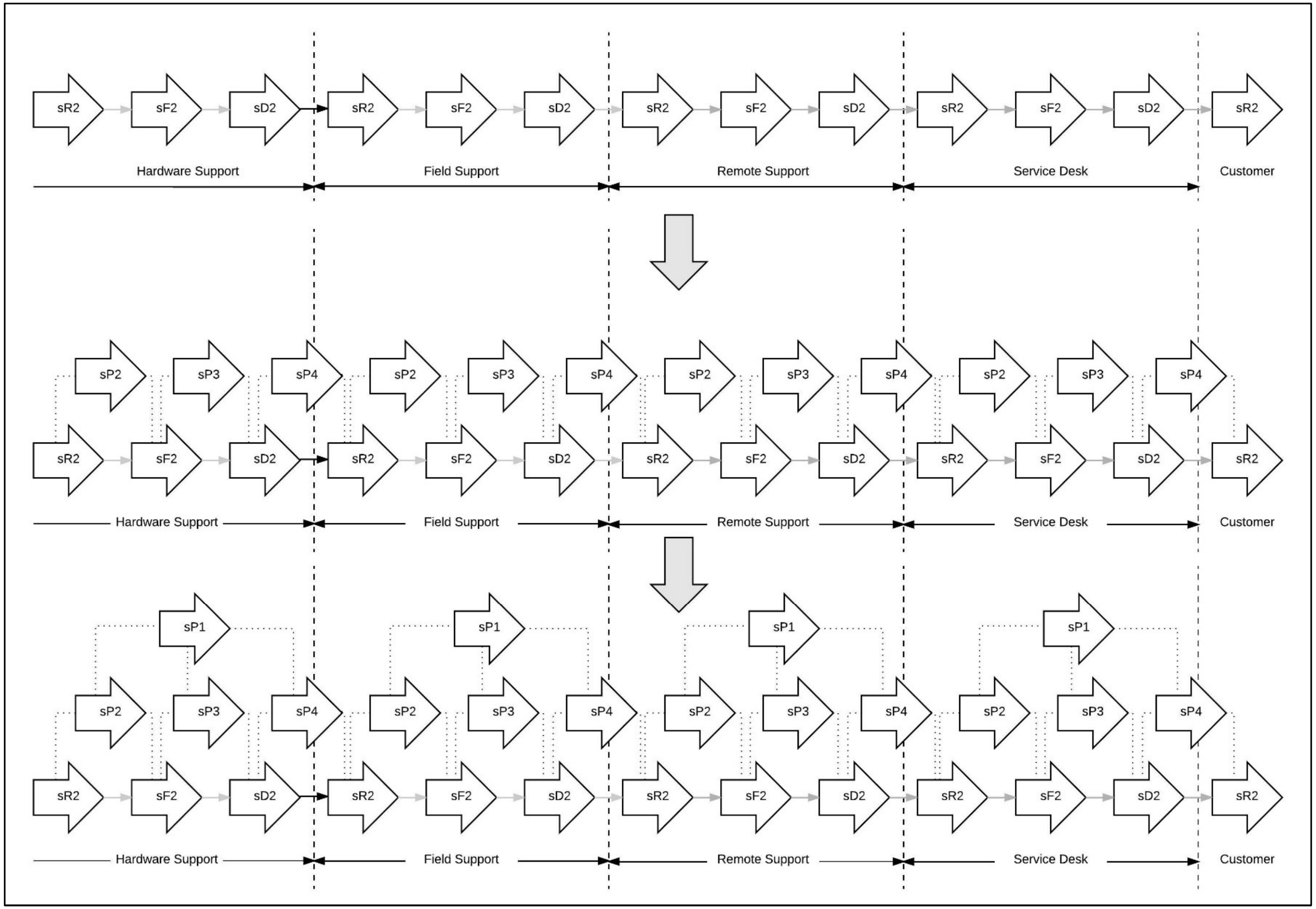

Figure 57: As-Is Process for End User Support

B.6.1 Exercise 2

1. Plot the execution processes
2. Plot the plan processes (sP2 – sP4) of the execution processes
3. Plot the sP1 processes

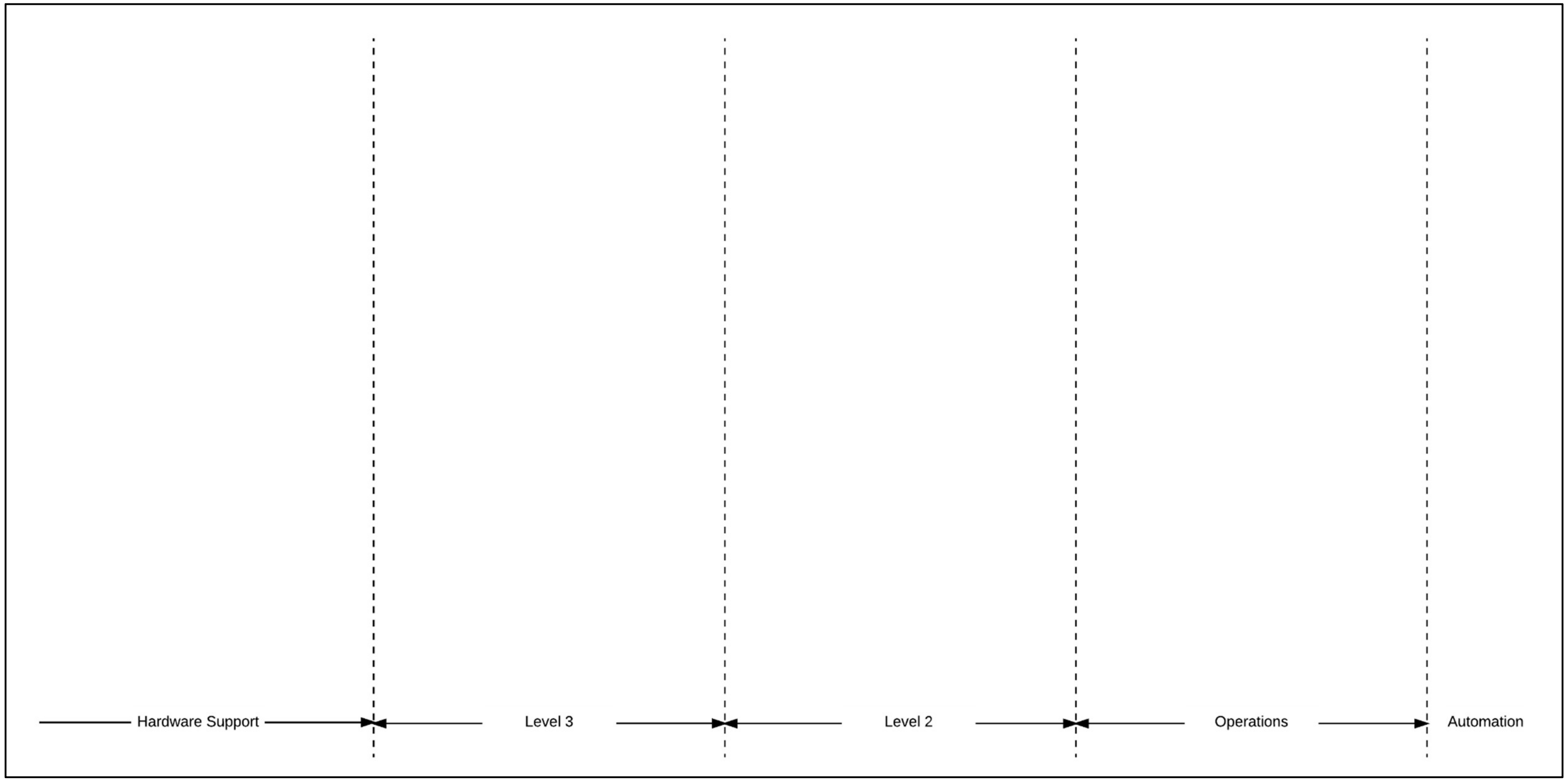

Figure 58: As-Is Process for Server Support

B.7 Performance Metrics

The previous two exercises were used to draw the Supply Chain and provide an overall configuration within which the supply chain can be described. This approach assists in creating structure and identifies all the elements that are involved in the service supply chain.

Now that the Supply Chain that is being considered has been defined, the analysis of this Supply Chain can now be done. Here we focus on the level one performance metrics shown in Table 42.

Table 42: Level 1 Performance Metrics

Performance Attribute	Level-1 Strategic Metric
Reliability	Perfect Order Fulfillment (RL.1.1)
Responsiveness	Order Fulfillment Cycle Time (RS.1.1)
Agility	Upside Supply Chain Flexibility (AG.1.1) Upside Supply Chain Adaptability (AG.1.2) Downside Supply Chain Adaptability (AG.1.3) Overall Value At Risk (AG.1.4)
Costs	Total Cost to Serve (CO.1.001)
Asset Management Efficiency (Assets)	Cash-to-Cash Cycle Time (AM.1.1) Return on Supply Chain Fixed Assets (AM.1.2) Return on Working Capital (AM.1.3)

These are the metrics that are important when considering the Supply Chain as a whole. As was seen in the previous section, a sP1 plan process is assigned to each thread. The reader should thus look at the sP1 elements for each of the different parties in the supply chain. This will be the approach when considering all the different companies in the supply chain. In this exercise we want to group all the metrics to a global metric overall across the entire supply chain.

When looking at the performance measures, you should also have benchmarking data to compare each of the metrics to that of the market. You will obtain benchmarking results through your observations and experience in the market. You may also obtain benchmarking information by contracting specialist-benchmarking companies to provide industry benchmarks. The process of benchmarking is beyond the scope of this case study.

Table 43 provides the calculated performance for the End User Support Process together with the benchmark data obtained.

Table 43: Benchmark Data for End User Support

Level-1 Strategic Metric	Actual	Parity	Advantage	Superior
Perfect Order Fulfillment (RL.1.1)	■■■	■■■	■■■	■■■
Order Fulfillment Cycle Time (RS.1.1)	■■■	■■■	■■■	■■■
Upside Supply Chain Flexibility (AG.1.1)	■■■	■■■	■■■	■■■
Upside Supply Chain Adaptability (AG.1.2)	■■■	■■■	■■■	■■■
Downside Supply Chain Adaptability (AG.1.3)	■■■	■■■	■■■	■■■
Overall Value At Risk (AG.1.4)	■■■	■■■	■■■	■■■
Total Cost to Serve (CO.1.001)	■■■	■■■	■■■	■■■
Cash-to-Cash Cycle Time (AM.1.1)	■■■	■■■	■■■	■■■
Return on Supply Chain Fixed Assets (AM.1.2)	■■■	■■■	■■■	■■■
Return on Working Capital (AM.1.3)	■■■	■■■	■■■	■■■

At this point the idea is that the company obtains benchmarking data. The benchmarking exercise is not part of this tutorial although it should be said that benchmarking results can be obtained at reasonable prices when the company participates in benchmarking exercises. At first glance this table might seem intimidating. There are a number of calculations and terms used, but what are they exactly.

The first issue to clear up would be the terms used. The SCOR model also includes a glossary. All metrics, process elements and inputs and outputs (discussed later) are given in this glossary. Take for example the cash to cash cycle time. The adapted service SCOR glossary defines cash-to-cash cycle time as "the time from the point where a company pays for the resources consumed in the performance of a service to the time that the company received payment from the customer for those services."

Using this definition, you can consider the point at which the entire supply chain has expenditure for running the supply chain up to the point where money is received for the service that is delivered. The following sections will elaborate on these calculations for the End User Support Service.

It is important to note that the various metrics may not apply exactly to your service you are considering, but in general the metric should be applicable in some form. The metric may be adapted slightly to apply better for your supply chain.

B.7.1 Calculating End User Support Metrics

The following sections will elaborate on calculating the end user support metrics and also provide context as they apply in the detailed supply chain.

RL1.1 Perfect Order Fulfilment

The definition provided for Perfect Order Fulfilment in the adapted service SCOR glossary is "the percentage of orders meeting delivery performance with complete and accurate documentation. Components include all items and quantities on-time using the customer's definition of on-time, and documentation." The definition may sound very intimidating but in the case of end user support this metric is very simply translated to the number of incidents or tickets that are delivered within the contracted service level agreement (SLA) for the service.

One could refine this measure even further to look at re-opened incidents bit for now, SLA compliance is sufficient for this point.

Using the given calculation of [Total Perfect Orders] / [Total Number of Orders] x 100% and using the case study we can thus see that from the study the company completed [redacted] tickets within the agreed timelines with the total number of tickets being [redacted] in the last month. The Perfect Order Fulfilment is thus [redacted]%.

RS1.1 Order Fulfilment Cycle Time

The definition provided for Perfect Order Fulfilment in the adapted service SCOR glossary is "the average cycle time consistently achieved to fulfil customer orders. For each individual order, this cycle time starts from the order receipt and ends with customer acceptance of the order. Time where the order could not be fulfilled because the customer was not ready or where the customer asked for the service to be delivered at a future date are excluded from the cycle time."

Again at first glance the definition may seem intimidating but for End User Support specifically this is simply the average time it takes from the customer logging an incident up to the point where the incident is resolved. The definition also allows for time when the incident could not be progressed because the customer was not available.

The calculation from the adapted service SCOR glossary is [Sum Actual Cycle Times for All Orders Delivered] / [Total Number of Orders Delivered] in days. In the case of our example the measure of days is not granular enough and hours is more appropriate. Considering this the actual value of the measure is given which is the average time to resolve that is given in the performance data. The average time to resolve the tickets is given as [redacted] hours across all the tickets. The time for each area may be different for the various areas individually but overall the time to resolve may be different based on the volumes of tickets each area must resolve.

Note: the difference between Perfect Order Fulfilment and the Order Fulfilment Cycle Time. You may on average have a low Order Fulfilment Achievement time because of the number of occurrences of incidents being fulfilled quickly, but overall you may still have a challenge to meet the Perfect Order Fulfilment criteria if there are a few orders that exceed the specified level of resolution time and this number is higher than the allowed number contracted. Both measures are thus useful with a different focus although they may seem similar.

AG.1.1 Upside Supply Chain Flexibility

The definition for Upside Supply Chain Flexibility is given as "The number of days required to achieve an unplanned sustainable 20% increase in quantities delivered" in the adapted service SCOR model. The value of 20% is an arbitrarily chosen number.

From the case study, it is seen that capacity can be increased within

- [redacted] days for the Service Desk,
- [redacted] days for Remote Support,
- [redacted] days for Field Support, and
- [redacted] days for Hardware Support

The overall flexibility in the chain for the Supply Chain Flexibility is thus [redacted] days as the entire chain will be dependent on the longest element in the chain.

Note: Flexibility may generally not be as critical for the service End User Support. It is very relevant when it comes to handling requests in services or when the customer requires a sudden take on. The measure thus just has value in specific scenarios.

AG.1.2 Upside Supply Chain Adaptability

The definition for Upside Supply Chain Flexibility is given as "The maximum sustainable percentage increase in quantity delivered that can be achieved in 30 days" in the adapted service SCOR model. The value of 30 days is an arbitrarily chosen number.

From the case study, it is seen that capacity can be increased within

- [redacted]% within 30 days for Service Desk
- [redacted]% within 30 days for Remote Support,
- [redacted]% within 30 days for Field Support, and
- [redacted]% within 30 days for Hardware Support

The overall flexibility is thus limited to [redacted]%, which is the lowest number of flexibility from all the various parties in the supply chain.

AG.1.3 Downside Supply Chain Adaptability

The definition for Downside Supply Chain Flexibility is given as "The reduction in quantities ordered sustainable at 30 days prior to delivery with no inventory or cost penalties" in the adapted service SCOR model. The value of 30 days is an arbitrarily chosen number.

The previous measures considered the ability of the overall supply chain to increase throughput and also the time required for a large increase in throughput. The downside flexibility considered for the End User Support service is [redacted]. This is based on the fact that the reduction in any of the services is dependent on a redeployment or reduction of resources. In all cases the nature of the service is one that the resources will not easily be transferable to a new service so downside flexibility will be linked to [redacted] days.

The hardware support has an agreement that services may be terminated within [redacted] days and has sufficient economies of scale in other contracts.

Note: This may not be reasonable within services but is very relevant. The supply chain may be able to meet adaptability in such a limited time by providing stipulations of taking over of stranded assets and the existing employees. This measure is thus very relevant to services.

AG.1.4 Overall Value at Risk

The Supply Chain Value at Risk is defined as "the sum of the probability of risk events times the monetary impact of the events which can impact any core supply chain functions (e.g. Plan, Request, Fulfil, Deliver and Return) or key dependencies" in the adapted service SCOR model.

The case study highlights that a failure in KPI results in a R1 million penalty per month or R[redacted] million per year. The probability of not meeting the set KPI's in any given month is estimated as [redacted]%.

The simple Value at Risk calculation is given as: Probability of Risk Event (P) x Monetized Impact of Risk Event (I). The Overall Value at Risk is thus R[redacted] thousand

CO.1.001 Total Cost to Serve

The definition for Total Cost to Server is given as "the sum of the supply chain cost to deliver services to customers" in the adapted service SCOR model. The unit of measure is not given in the definition although it is mentioned that the measure may be given in a cost per event charge although this requires detailed analysis. In the case of End User Device support this may also be on a cost per unit (or device) charge. Both these measures are relevant.

In this case the customer is charged on a cost per device basis, so the calculation is done on a cost per device measure. From the calculation, the costs of the various parties of the supply chain are added to result in an overall cost per device of R[redacted].

Note: Some of the cost basis for various parties in the Supply Chain may be different. As an example the charges from the Service Desk may be per ticket and not per device. The approach of changing the units of measure throughout the supply chain should also be considered to optimise costs in the supply chain

AM.1.1 Cash-to-Cash Cycle Time

The definition of Cash-to-Cash Cycle Time was given as "the time from the point where a company pays for the resources consumed in the performance of a service to the time that the company received payment from the customer for those services" in the adapted service SCOR model.

This measure is more applicable on the individual entity level and not as much on the overall chain as one would use the financial statements to calculate this measure. For this case study this can be derived that all costs are paid immediately as the largest cost in the chain is based on labour cost with employees requiring payment each month as they perform work. The customer has a contracted agreement that all invoices are payable within [redacted] days. The Cash-to-Cash cycle time is thus calculated as [redacted] days.

Note: This is an oversimplification of the measure. Using the financial statements of the company to analyse the statements to calculate this value normally performs this calculation.

AM.1.2 Return on Supply Chain Fixed Assets

Return on Supply Chain Fixed Assets measures the return the supply chain achieves on investments the company has made. As with the previous measure, this measure is more suited to considering an individual company within the supply chain and using financial statements to measure this value.

The calculation of this measure is given as ([Supply Chain Revenue] – [Total Cost to Serve]) / [Supply-Chain Fixed Assets]. The only Fixed Asset given for the End User Support service is the cost of the buildings linked to the chain. In this case the measure results in [redacted] (profit in a year divided by fixed assets).

AM.1.3 Return on Working Capital

Return on working capital is defined as a "measurement which assesses the magnitude of investment relative to a company's working capital position versus the revenue generated from a supply chain" in the adapted service SCOR model.

The calculation for this measure is: Return on Working Capital = ([Supply Chain Revenue] – [Total Cost to Serve]) / ([Inventory] + [Accounts Receivable] – [Accounts Payable]).

From the previous section it was stated that there are no accounts payable as the largest cost is employee salaries which is payable immediately. The customer payment is [redacted] days or thus [redacted] months of revenue. Finally, the profit can be calculated from the revenue less the cost of the service. The final Return on Working Capital is thus calculated as [redacted]% (profit in a Year divided by [redacted] times the Revenue)

B.7.2 Exercise 3

It is now your turn to calculate the various performance figures of each of the Level 1 metrics for the IT Server Support process. The answers to each of the metrics are given in each of the blocks. The correct answers are not as important as the process of getting to the right answers, so make sure that the correct method is understood.

Remember that the adapted service SCOR model has all the definitions that you need to calculate the metrics.

You are not asked to calculate all the measures. There are a few measures that you will be asked to calculate as part of the case study that was given for the IT Server Support process.

Perfect Order Fulfilment (RL.1.1)	
	[redacted]%

Order Fulfilment Cycle Time (RS.1.1)	
	[redacted]

Upside Supply Chain Flexibility (AG.1.1)	
	■■

Overall Value At Risk (AG.1.4)	
	■■■■

Total Cost to Serve (CO.1.001)	
	■■■■

You have now completed the SCOR card for the IT Server Support service. The table below (Table 44) shows the completed benchmark table with the relevant benchmark data.

Table 44: Benchmark Metrics for Server Support

Level-1 Strategic Metric	Actual	Parity	Advantage	Superior
Perfect Order Fulfillment (RL.1.1)	[redacted]	[redacted]	[redacted]	[redacted]
Order Fulfillment Cycle Time (RS.1.1)	[redacted]	[redacted]	[redacted]	[redacted]
Upside Supply Chain Flexibility (AG.1.1)	[redacted]	[redacted]	[redacted]	[redacted]
Upside Supply Chain Adaptability (AG.1.2)	[redacted]	[redacted]	[redacted]	[redacted]
Downside Supply Chain Adaptability (AG.1.3)	[redacted]	[redacted]	[redacted]	[redacted]
Overall Value At Risk (AG.1.4)	[redacted]	[redacted]	[redacted]	[redacted]
Total Cost to Serve (CO.1.001)	[redacted]	[redacted]	[redacted]	[redacted]
Cash-to-Cash Cycle Time (AM.1.1)	[redacted]	[redacted]	[redacted]	[redacted]
Return on Supply Chain Fixed Assets (AM.1.2)	[redacted]	[redacted]	[redacted]	[redacted]
Return on Working Capital (AM.1.3)	[redacted]	[redacted]	[redacted]	[redacted]

B.8 Performance Attributes

Now that the level 1 performance metrics have been completed, the most important of these metrics need to be identified. At this point in time the metrics should be linked to the strategy of the company. Here the reader should keep the case study presented in mind to consider the importance of the various factors that determine the success of the product lines.

At this point level 1 performance attributes have to be rated. It is suggested that the attributes should be rated by choosing one to be an attribute that has to be superior in comparison to that of the competition for the service, two that is at the advantage level and lastly two that are on the parity level. This forces the user to identify only one superior attribute. The reasoning to this approach is simply that it is very difficult to be the best at everything. Very few companies can focus on all aspects of the Supply Chain and bring them all to a superior level; the idea is rather to apply incremental change.

Here the choice of the correct phase is greatly dependent on the opinion of the person performing the analysis and how they see their strategies. Most people feel that asset utilisation is the most important thing with a Mature product. Reliability and quality are merely attributes that require parity with the levels of competitors as the product is now mass-produced and is similar to many other products on the market.

A different person may feel that they could still differentiate from the market by still providing superior quality and reliability and this is then the most important factor. Which answer is correct? Both, it depends on what the strategy of the company, of the team and of the individual is.

Now that the various levels of competition for the performance attributes have been identified, they need to be translated to physical performance levels. Here we refer back to the benchmarking data obtained earlier. The task is now to identify those performance metrics that will result in the performance attribute levels as chosen above.

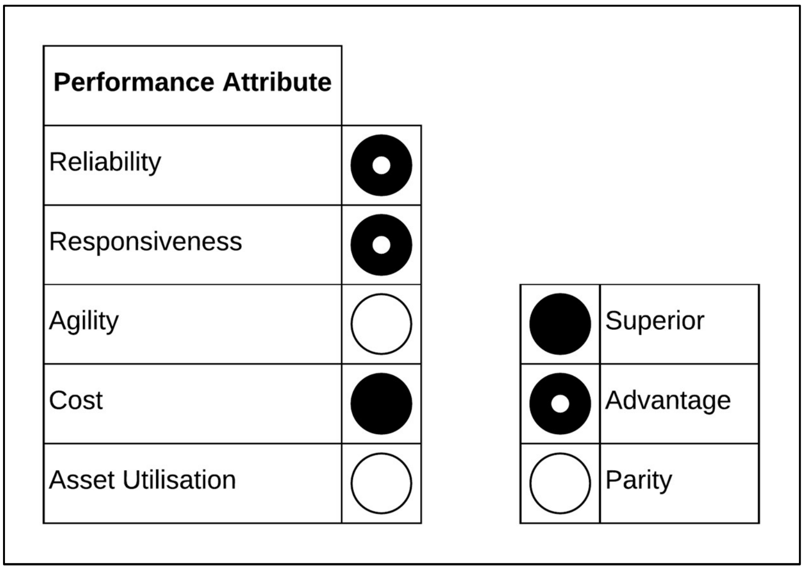

Figure 59: GAP Analysis for End User Support

For the end user support the challenge was shown to be a cost competitive market requiring 10% reductions year on year and this can currently not be met. Further it was said that customers have an expectation of faster turnaround times. Also, the company prides itself on its superior quality achievement. Agility to quickly adapt to an increase or decrease in market demand is less important to the End User Support service. Similarly, a return on assets employed is less important for the success of the End User Support service.

Because of this diverse set of choices, the exercise will allow time for the reader to choose which attributes should be superior, advantage, and parity. The reader should then continue using the attributes provided by the tutorial.

B.8.1 Exercise 4

Complete the GAP analysis for the New product line on the table given below.

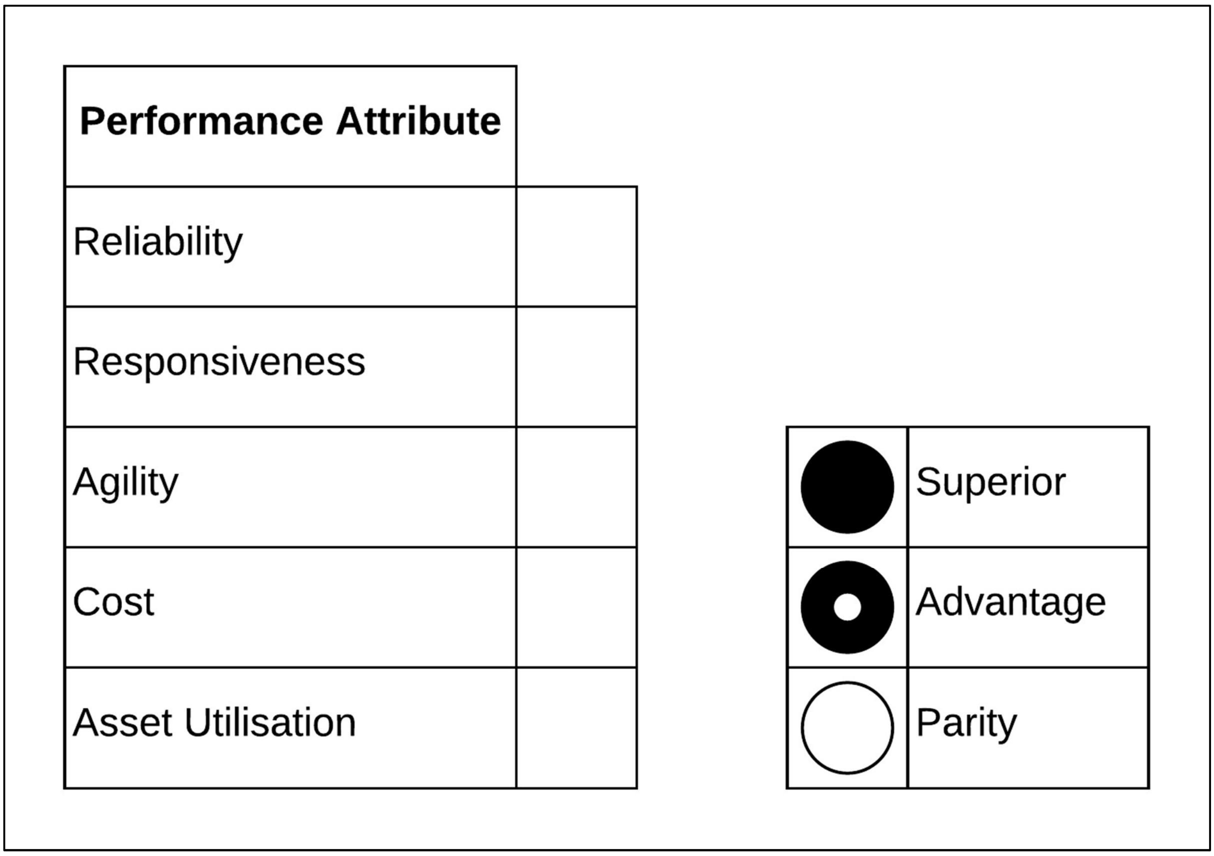

Figure 60: GAP Analysis Exercise 4

B.8.2 Exercise Discussion

Figure 61 shows the various importance of the attributes that would allow the service to become competitive. The reasons for choosing these metrics should now be discussed.

Cost is given as an item for the advantage. The market is expecting a drop beyond [redacted]% and the current configuration of the service does not allow this drop of price. The market is willing to consider other characteristics like quality and time to respond but for this the service must at least be at an advantage level. The Reliability is seen as a measure of quality and is the most important measure for the Server Supply Chain. Responsiveness is then further important on the advantage as customers would like issues resolved as speedily as possible but this is with the right price point as well as high levels of quality.

Agility and Asset Utilisation is less important in these services. Customers are impatient when requiring a service but the nature of the service is currently that the service is procured via a long-term contract. There is thus generally a lead-time allowed to ramp up the service. The market is set to change from this approach but may only become a real differentiator in future. Currently customers mention flexibility as a consideration but during the buying cycle this is one of the least important considerations.

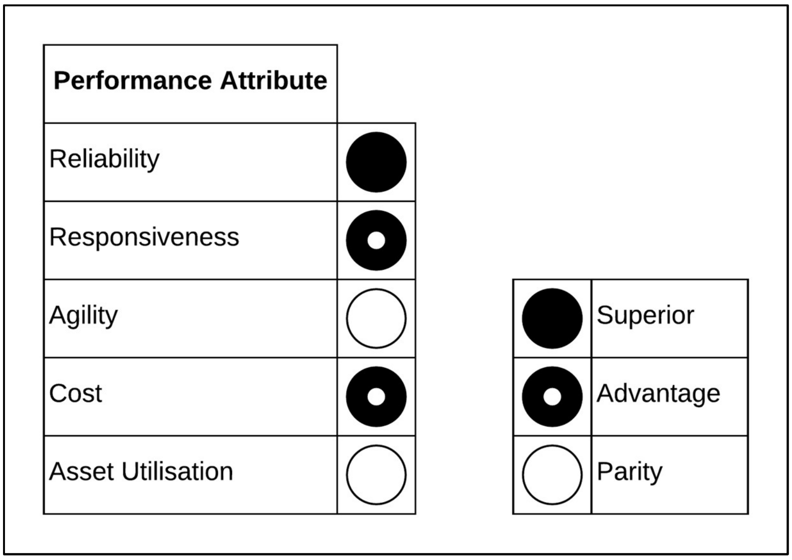

Figure 61: GAP Analysis for IT Server Support

B.9 GAP Analysis Metrics and Cascading

The previous section looked at the performance metrics that need to be improved on. It is now important to translate these measures into more tangible targets. It is important to note that these are all rough estimations based on the case study given. The below calculations will show some methods of getting to more practical target measures.

The most important measure given was that of Cost. From the analysis it is seen that for cost to get to Superior, which has been identified as the target, for this the benchmarking data shows that the cost per unit must drop by R[redacted] per device. Given the data of supporting [redacted]devices, the entire supply chain must take R[redacted] out of the end-to-end supply chain.

For the measure of responsiveness, the time to resolve a support ticket must move from [redacted] hours to [redacted] hours. It this case it must be kept in mind that the [redacted] hours are not equally spread over the entire supply chain. The nature of the end user support process is such that as the ticket progresses from the customer to the original supplier tickets take longer to resolve, but also that more tickets would have been resolved in the path. With the view that there are [redacted] tickets logged, a saving of [redacted] hours requires a reduction of [redacted] hours across the supply chain.

For reliability, the performance must move from [redacted]% to [redacted]% compliance. This [redacted]% change in volume is linked to [redacted] tickets logged in a month. This requires an improvement of [redacted] of the tickets not to exceed the required service levels.

These measures are not useful to start driving behaviour on a global end-to-end level unless each member of the supply chain can be held accountable to their contribution toward the measure. The following section will look at various techniques and dimensions toward the analysis of the metrics as they relate to each partner within the supply chain.

B.9.1 Cascading of Metrics

This section will look at how metrics are cascaded across the various dimensions of the supply chain. Consider the cost saving across the entire supply chain. If one considers the R[redacted] million saving that was calculated, the more important portion is how is that spread across the supply chain. Now look at each of the actors in the end-to-end supply chain. If we break that cost up proportionately to the cost contribution of the end-to-end chain, we see that the contributions of each of the actors are:

- Service Desk: [redacted]%
- Remote Support: [redacted]%
- Field Support: [redacted]%
- Hardware Support: [redacted]%

This gives us a method to spread the overall measure to set targets to each unit of how much they must cut. But It is also useful to do some further analysis. For each of the areas, consider the cost device but also the cost per ticket that has to be reduced. This is summarised in the table below (Table 45):

Table 45: Cost Analysis of End User Service

	Total Cost	Required Saving	Cost per Device	Saving per Device	Cost per Ticket	Saving per Ticket#
Service Desk	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Remote Support	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Field Support	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Hardware Support	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]				

From this table a number of interesting observations van be made. If one looks at the overall cost contribution of the Hardware Support, it seems low. When one considers that very few tickets are routed to the Hardware Support supplier the cost per ticket is very high. It is questionable if one should be contracting a Hardware Support provider at all.

The Field Support charge per device makes up a large portion of the overall charge and the cost per ticket is also large. This is valid the field support ticket requires a physical visit to the end user.

The breakdown of cost per device or cost per tickets is not formally part of the SCOR model. The SCOR model provides for a framework in which the readers can expand their own metrics for further analysis.

In cascading the measure of responsiveness, it was discussed that the overall time from [redacted] hours to [redacted] hours, we need to take on average 1 hour out of the chain. Because not all tickets run across the entire chain, one needs a method of approximating the resolution timelines. One method would be to as with the costs apportion the time per the overall contribution of the supply chain. The case study gave various time to resolve elements for each element in the supply chain. By multiplying the average time to resolve a ticket by the number of tickets for each actor in the supply chain will provide a measure of contribution to the overall supply chain time to resolve. Essentially if you take that the target is to move from [redacted] hours to [redacted] hours we require a [redacted]% reduction in the time to resolve in each of the actors. The resulting targets that are then cascaded across the supply chain are thus:

Table 46: Responsiveness of End User Service

	Total Time	Adjusted Time Allowed	Adjusted Time per Ticket
Service Desk	[redacted]	[redacted]	[redacted]
Remote Support	[redacted]	[redacted]	[redacted]
Field Support	[redacted]	[redacted]	[redacted]
Hardware Support	[redacted]	[redacted]	[redacted]
	[redacted]	[redacted]	

This is a simply approach to spread the measure evenly. A more refined way would to not simply enforce a straight reduction approach. As an example, if you assume the exact same average time to resolve but rather look to change the mix of tickets in the various areas, you could also get to an average of [redacted] hour reduction by moving more of the tickets from Field Support to Service Desk and Remote Support. As an example, by resolving [redacted] tickets more in service desk and [redacted] tickets in remote support you will get a total saving of [redacted] hours per month which still does not reach the average target of [redacted] hours per ticket but it does get to [redacted] from the current [redacted] hours. This shows that a simply linear approach to supply chain optimisation is one approach but a rebalancing of ticket volumes may achieve the targets as well and may be more practical.

For the measure of reliability, [redacted]% improvement in service level achievement must be achieved. This was calculated to be an improvement of [redacted] tickets. The changes discussed in the previous section of responsiveness may have already achieved this as reliability includes on time delivery. This measure is very complicated to cascade as the experience of the customer is for the entire chain. It is also difficult to attribute ownership of the measure as due to the nature of the chain, tickets tend to breach required service levels towards the end of the chain furthest away from the client although each member in the chain may have contributed to the overall breach. One approach is to take the overall service level and to define new service level agreements to each member of the chain that eventually reconcile to the overall service level. The challenge is that this creates multiple measurements and calculations that adds additional overhead and administration. For now, the measure will be kept as an overall supply chain measure that will be linked to each actor rather than creating a separate measure for each actor.

A different approach that can be taken is not to spread the measure, but rather the consequences. Many breaches in Service Levels are related to consequence, management through some punitive measure. An approach is then rather to spread the consequence across the chain proportionate to some measure, proposition of cost contribution.

The measures of Asset Utilisation and Adaptability will not be discussed in further in this case study. The measures of Asset Utilisation are internal to the company so cascading is less relevant on the overall supply chain and more relevant to the individual company so this measure is easier to calculate using the company's financial statements.

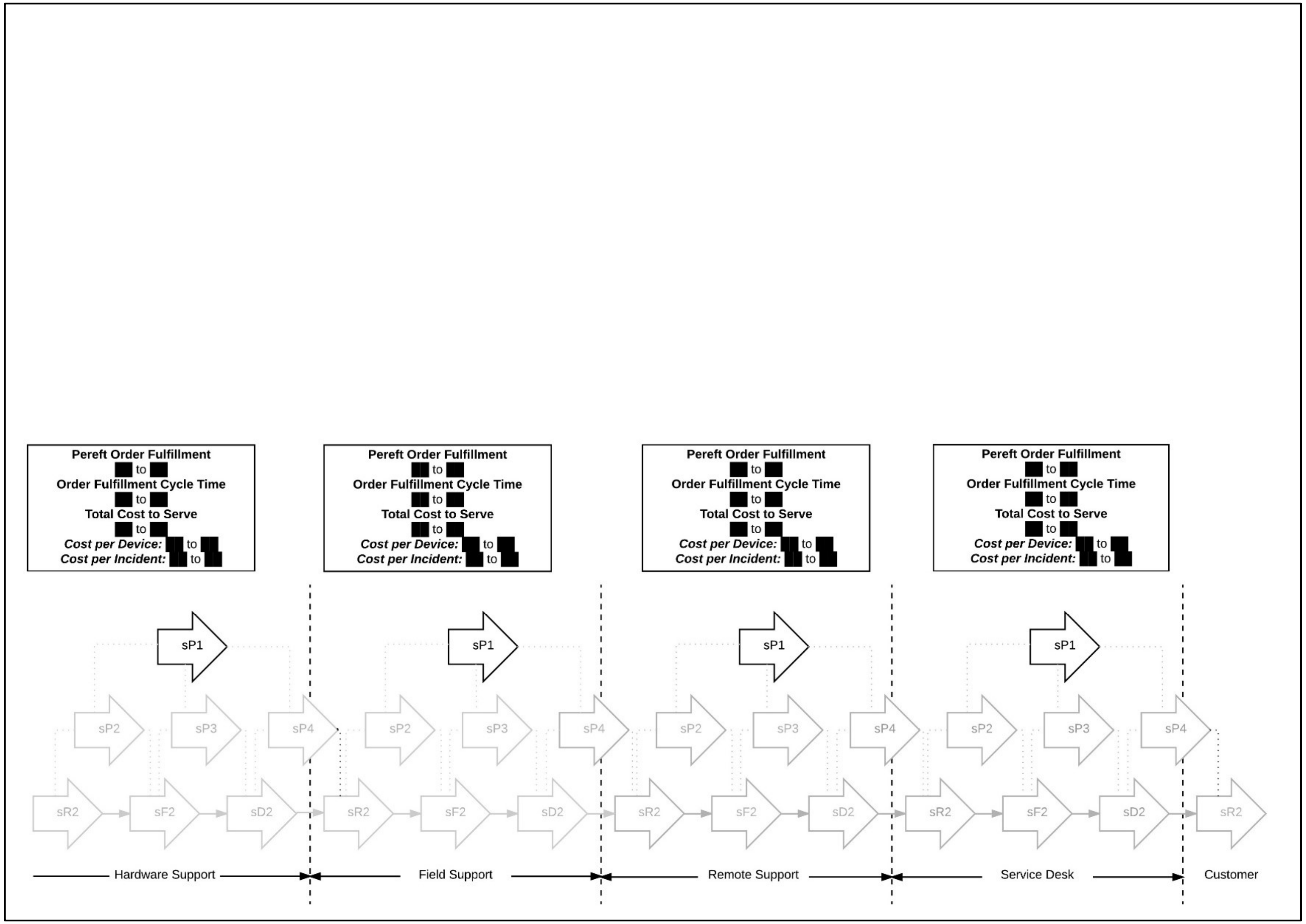

Figure 62: Cascaded Metrics for End User Support

B.9.2 Exercise 5

Now that the examples where shown for the measures of End User Support, take the time and calculate the various measures for IT Server Support. First do some calculations around the various measures, then complete the supply chain diagram and have a look at how these measures are translated across the entire supply chain.

Order Fulfilment Cycle Time (RS.1.1)	

Total Cost to Serve (CO.1.001)	

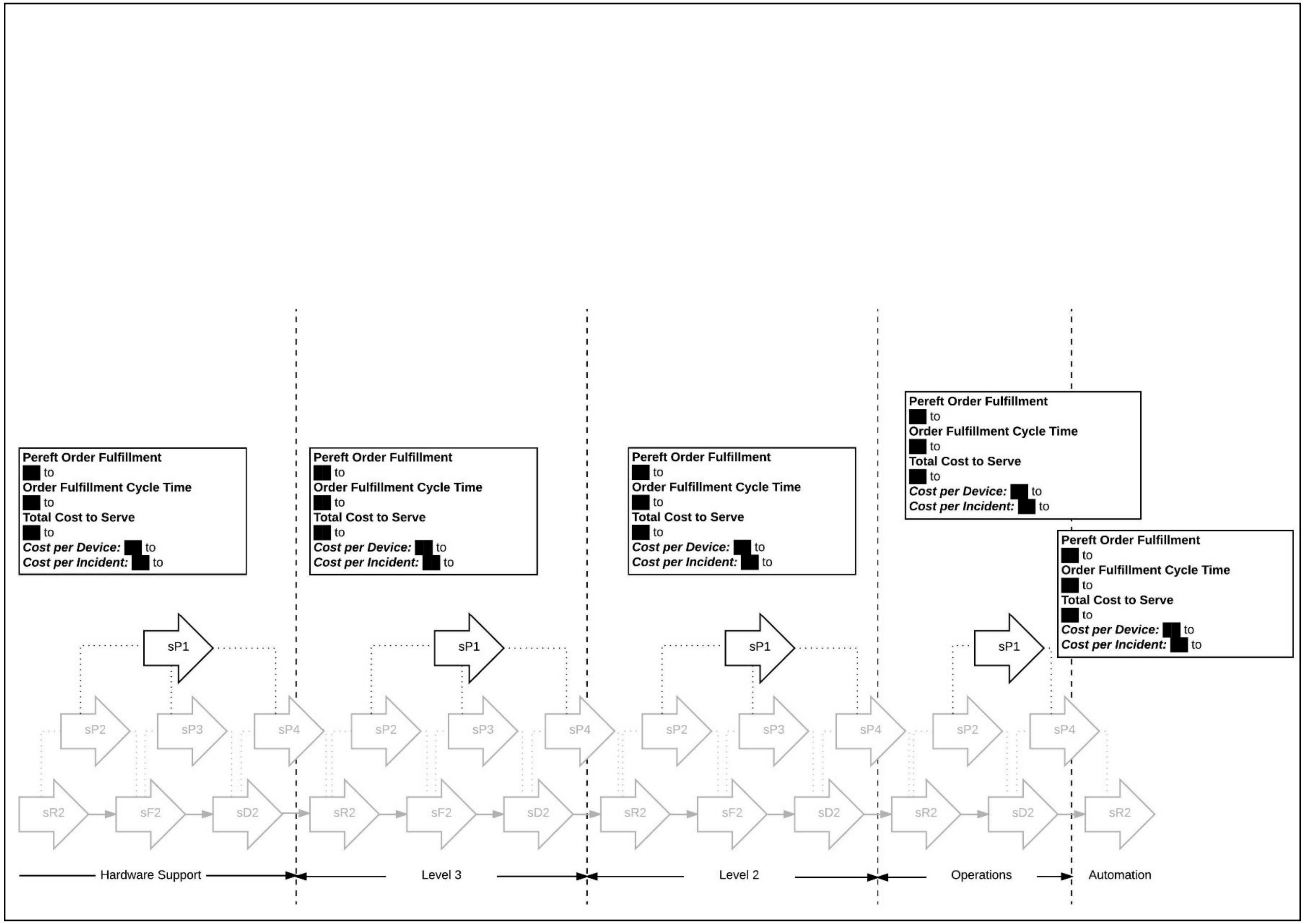

Figure 63: Cascaded Metrics for Server Support

B.10 Linking Metrics to the Supply Chain

In the previous sections the focus was on cascading the newly defined metrics of the overall supply chain to the various actors in the supply chain. This section will focus on the cascading of the supply chain for a specific company within the overall chain.

The following process may appear to be a number of unnecessary steps, as they could easily have grouped into one step or done without the complexity the step introduces. This is simply so because of the relative simplicity of the case study. A real-life scenario would be much more complex, so it is suggested that the steps be followed as described although the simplicity of the case study may make them seem trivial.

1) Choose any of the role-players in the chain. For this case study, we choose the Remote Support function. The sP1 metrics have already been compiled as part of the previous cascading exercise and is contained in Figure 63.
2) The metrics chosen for the sP1 process need to be broken down to smaller metrics that will be used to describe the sR (Request), sF (Fulfil) and sD (Deliver) processes. This seems like a tough task. Even for a person that is very familiar with the company being discussed will find it hard to immediately come up with metrics to describe the Supply Chain. This is where your adapted service SCOR model becomes very helpful. The sR1 process in the adapted service SCOR model presents a number of metrics that may be used for this step. You may also use some of the sR1 process elements' metrics here. The same can now be done for sF1 and sD1. Choose a maximum of five metrics. Note that there are also sP2, sP3 and sP4 sub process elements supporting sP1. These processes focus on planning and are more focus on supporting the planning measures. The sR, sF and sD process elements are targeted at cascading the overall sP of the specific company.
3) Each of these metrics must now be assigned targets as was done for the sP1 metrics. In this case, the combination of the sR1, sF1 and sD1 metrics must result in the sP1 metric. Take for example Order Fulfilment Cycle Time, which must be decrease from 2 hours to 1,67 hours. On the detailed level this may be made up out of Request Cycle Time from sR1, Fulfil Cycle Time for sF1 and Deliver Cycle Time for sD1. In this case the time for each of these processes need to be built into the process that make up the overall time. If we thus take an example where we are procuring services from other suppliers, we would add the time to procure in this step to the sR1 (Request).
4) At first it may be difficult to see the benefit of the Request and Fulfil elements in the way the case studies have been setup. In the case of multiple vendors that may be selected as for requests, the Request and Deliver blocks would be more relevant. A separate discussion on the use of Request and Fulfil in the context of services is included in the following chapter to illustrate the use of these elements. For the purpose of this case study and the task of this chapter, cascading elements to sub elements the Fulfil block is more easily understood. Looking at the definitions within Fulfil, the measures that relate to cost are very important. Using these measures one can look at improving the overall cost elements. These additional cost elements are Service Fulfilment Cost, Service Fulfilment (Direct) Labour Cost and Service Fulfilment Automation Cost. These measures are shown in Figure 64.

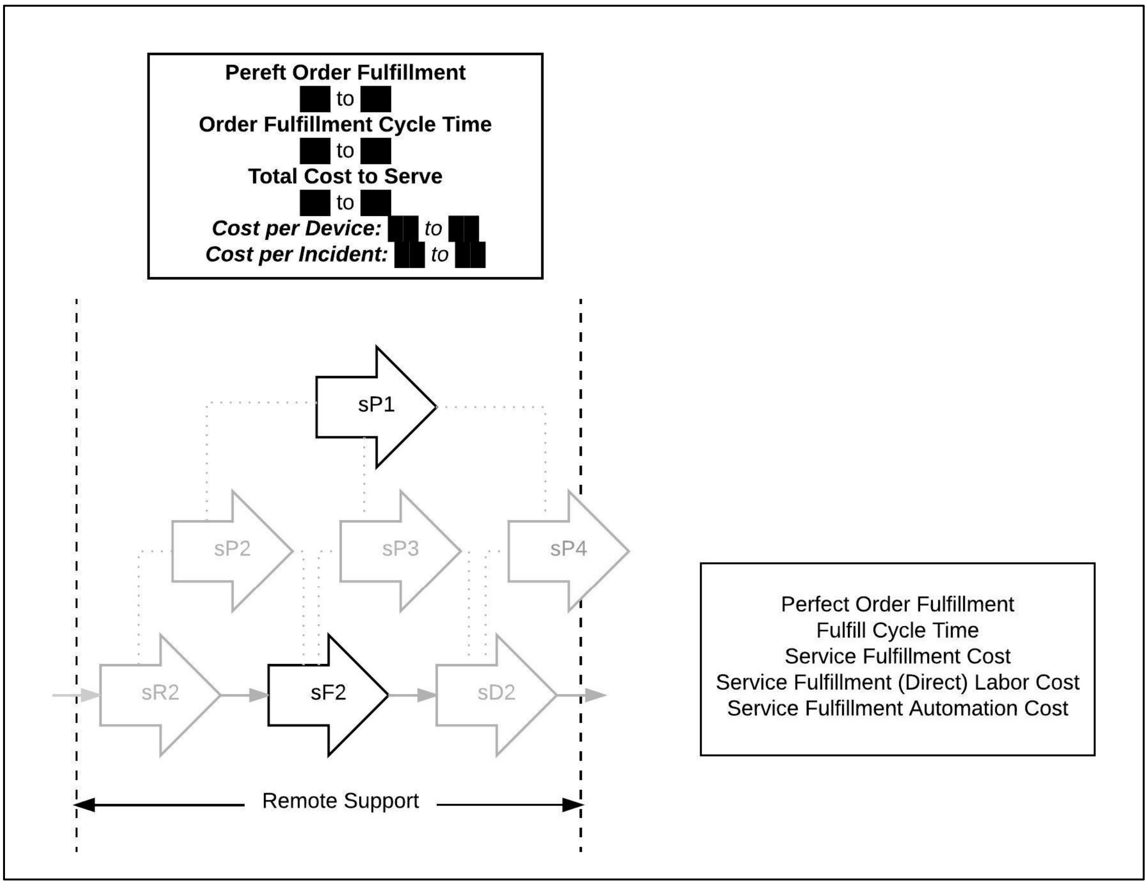

Figure 64: Cascading Measures for Fulfil in Remote Support

This section illustrated how the metrics are related to the goals of lower level activities that can be applied to various parts of the Supply Chain. In some cases, the measures are hard to define or are not applicable (as in this case where the sourcing of the service is completed before hand). Metrics are available in the adapted service SCOR glossary, but these are only starting points. The reader is encouraged to come up with more suitable measures that may be applicable to the specific supply chain being investigated.

The reader could easily skip this chapter, although it may be interesting to understand some of the possible solutions to the current Supply Chains as they are.

B.10.1 Exercise 6

List 5 measures you think you should measure that will help in improving the supply chain for the Level 3 area.

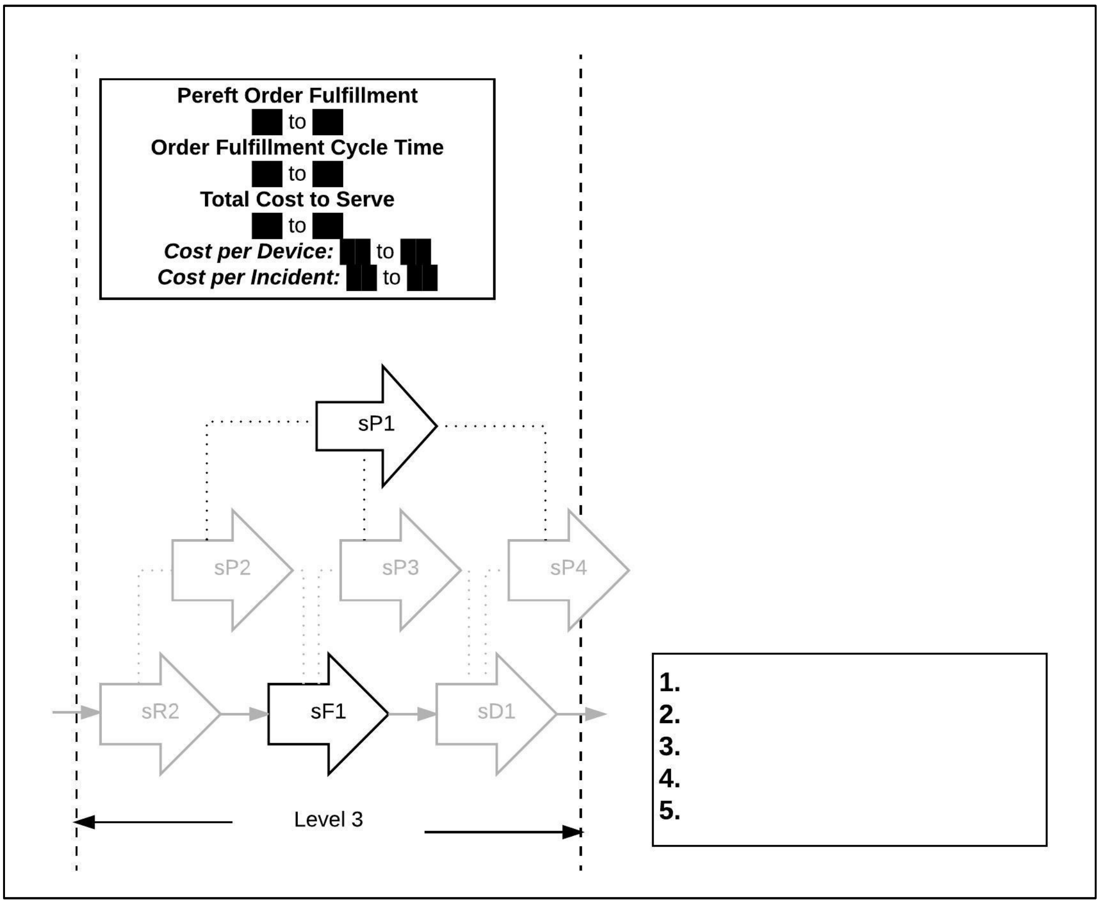

Figure 65: Cascading Measures for Fulfil in L3

B.11 Discussion on Request and Deliver

The use of Request and Deliver may not seem intuitive based on the high level at which the case study has been created. It is however useful to discuss these two elements as they may be of great value in modelling the supply chain within services.

In concepts are easily understood within manufacturing, the Request process is analogous to the Source process in manufacturing of requesting suppliers to provide quotes and to accept the work from suppliers. The Deliver process within manufacturing is easily understood to handle a request from a previous step in the supply chain for requesting a product up to the point where the requested product is delivered to the requesting party.

In services, there is no physical movement of product. This complicates the understanding of the two process elements of Request and Deliver. They are still valid within services. This section will discuss the uses of these elements. They do not form part of the overall case study but are included to illustrate their use in a practical implementation.

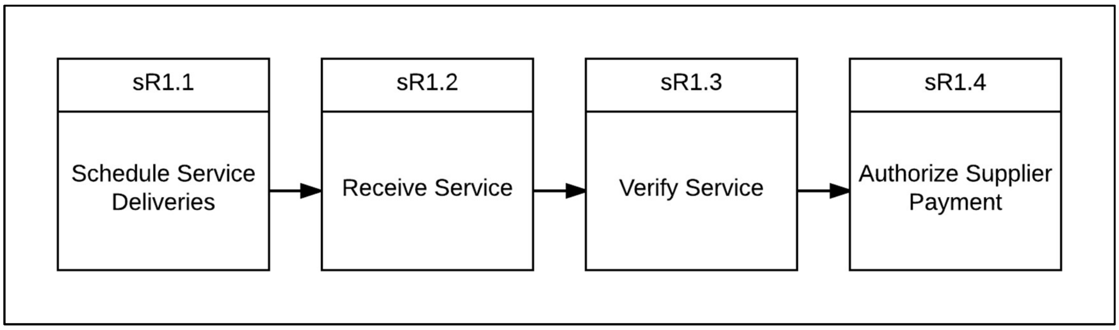

Figure 66: sR1 Request Scheduled Service

In looking at the sR1 (Request Scheduled Service) block the sub processes (Level 3 processes) that make up the block are basic steps to requesting a service and are relevant to services.

As an example, in the case of the End User Support service for WeRIT the Remote Support team contracts with external service providers to provide the Field Support service. This is achieved through a dedicated partner management team that manages the service providers in terms of invoicing, cost, delivery capability and escalations. In the overall model, this management of the external partners could fit into the sR1 block for Remote Support. The partner management team within the WeRIT Remote Support Unit would then typically have their own measures of cost as well as the time they take to move the request for service through their processes.

Similarly, the processes in the Field Support company would be to interface with the partner management of the Remote Support. The processes will be handled under the Deliver process elements. The sD1 (Deliver Scheduled Service) process elements are shown in Figure 67. Here the blueprint steps are applicable to interacting with the partner management team of WeRIT.

This process would have a cost and also time and turnaround measures making the process steps very relevant to services.

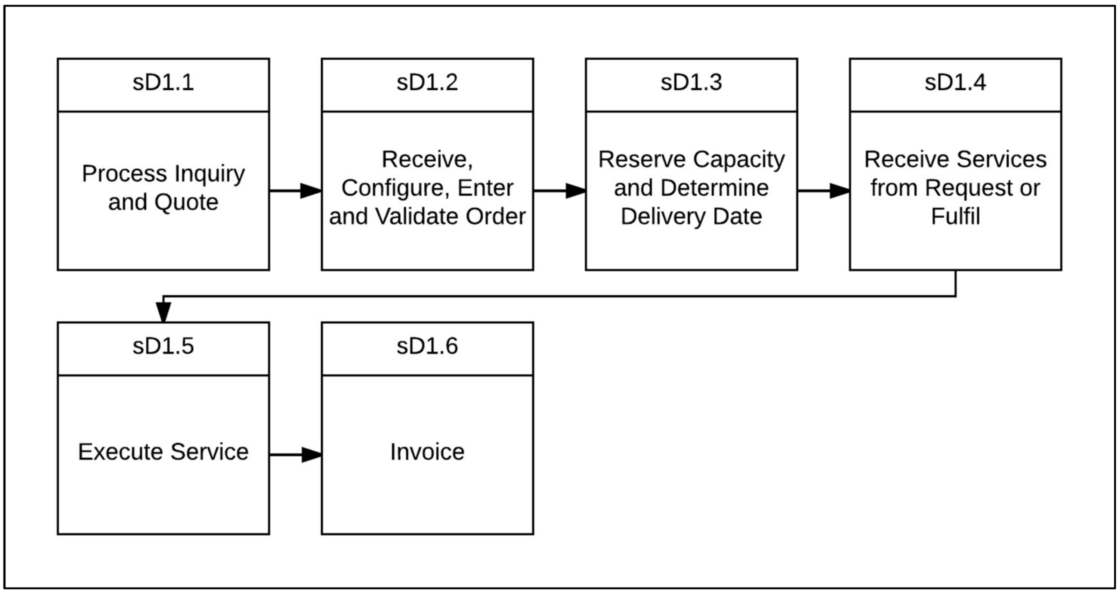

Figure 67: sD1 Deliver Scheduled Service

The above example and extension to the case study showed the role the Request and Deliver processes may play within a service. A further expansion on the case study is the role of Request and Deliver when there is not a team involved as in the case of partner management.

To expand the case study further, we look at examples where there is no management team but work is transferred automatically between the role players of the supply chain. As an example, for the End User Support process, tickets or work is routed automatically via a system from the Service Desk to the Remote Support team. There are no management functions in between. There is however enabling technologies in between. The automation and systems that exist to transfer work from the one area to the next should be seen as part of the Request and Deliver processes. This is also in line with the metrics of CO.3.006 Request Automation Cost and CO.3.019 Order Management Automation Cost, which are metrics for the Request and Deliver elements respectively. This may further include integration costs and costs to support the integration in the cases where the tickets move between different systems.

This chapter was a discussion on the role of Request and Deliver in services and how these processes should be considered within services. In highly automated processes it may appear that there is no Request or Deliver processes. This is not necessarily the case, as these processes may still require a cost or time to process through the very automation cost that improves the process.

B.12 Supply Chain Strategies

This chapter will discuss strategies that the company could attempt in improving their Supply Chain. These are not necessarily the only solutions; they are just typical examples that may be suited to the Supply Chain being investigated. The solutions may also be very specific to the case study being considered. Here it is up to the reader to apply their knowledge of their supply chains to come to an overall conclusion.

This chapter may be skipped without any disruption to the overall flow.

B.12.1 Evaluate Role of Each Role-Player

In considering the End User support process, one can evaluate the role each of the actors in the chain plays. In assessing the role of the Hardware Support provider, the cost per device is low but the cost per incident is very high. In considering alternatives to this approach, the service is very expensive because the Hardware Support provider must fix and hardware problems in a contracted time. Hardware providers of end user devices already provide warrantee services for their devices, the challenge is that these providers do not ensure adherence to service level agreements.

A possible solution is to ensure that there are spare devices available in the event that the user has a hardware failure. These devices are then issued to the user with the hardware problem while the users original device can be fixed by the warrantee agreement. The cost and time of the Hardware Support can thus be removed from the overall chain immediately reducing the overall cost by R80 per device.

The process elements will now change for Hardware Support as the process move from Unscheduled (sR1, sF1, sD1) to Scheduled (sR2, sF2, sD2) process elements

B.12.2 Use of Self Help

The process of calling a Service Desk to handle calls can be looked at. The trend is for users to capture their calls using some form of self-help feature. This may result in quicker time to resolve the issue of the user as well as a decrease in cost. Realistically one may consider a dual process where users are allowed to capture the calls via self-help or via telephone.

Self-help has a further benefit, which is to act as a hedge against inflation. In an inflationary scenario, personnel costs are expected to increase by inflation year on year. It is thus important to keep the inflationary nature of salaries in mind when looking at the cost of the supply chain and also the future costs of the supply chain.

B.12.3 Movement of Call Volume

In analysing the supply chain, the close calls can be resolved to the customer, the quicker the turnaround and the lower the overall costs are. An incident resolved by the Service Desk is a lower cost that a ticket resolved by Remote Support is lower than the cost of a ticket resolved in the field

Techniques and measures should be put into place to encourage the resolution of calls closer to the point where the customer raises the ticket or call in the overall supply chain.

B.12.4 Accounts Receivable and Accounts Payable

The customer terms in the supply chain is linked to a [redacted] day payment term. This is a very long period to allow the customer to settle their invoices. Agreements should be reached with customers for shorter payment periods. Discounts or breaks may also be offered to customers for shorter payback periods.

In the case of accounts payable, the removal of a Hardware Support supplier will mean a reduction in the amount to be paid to the supplier. Agreements should be put into place to increase the period and terms for invoice settlement for the supply of the Field Support. This should further improve the situation of the Cash to Cash cycle as well as the Return on Working Capital.

B.12.5 Conclusion

This chapter was a short discussion of some solutions to the company's problems. Ideas were basically thrown around to simply show how a simple problem could be filled with complexities. It also showed how a problem in one area could impact on a whole range of others.

The major decision made from here is the use of an alternative contact point to the customer in the form of self-help together with the change the role of the Hardware Support provider. This will not be seen explicitly in the process diagrams but will have a major influence in achieving the targeted benchmark numbers.

B.13 To-Be Supply Chain

The most important conclusion made in the previous chapter is the change of the self-help chain as well as the role of the Hardware Support provider. This means that the configuration diagrams need to be redrawn for the End User Support and IT Server Support supply chains.

This now works in the opposite order to mapping the as-is configuration. First processes are mapped in their threads; a pictorial mapping from the thread diagram then follows this.

The thread diagram for the End User Support can be seen in Figure 70. The pictorial diagram for the End User Support line can be seen in Figure 71.

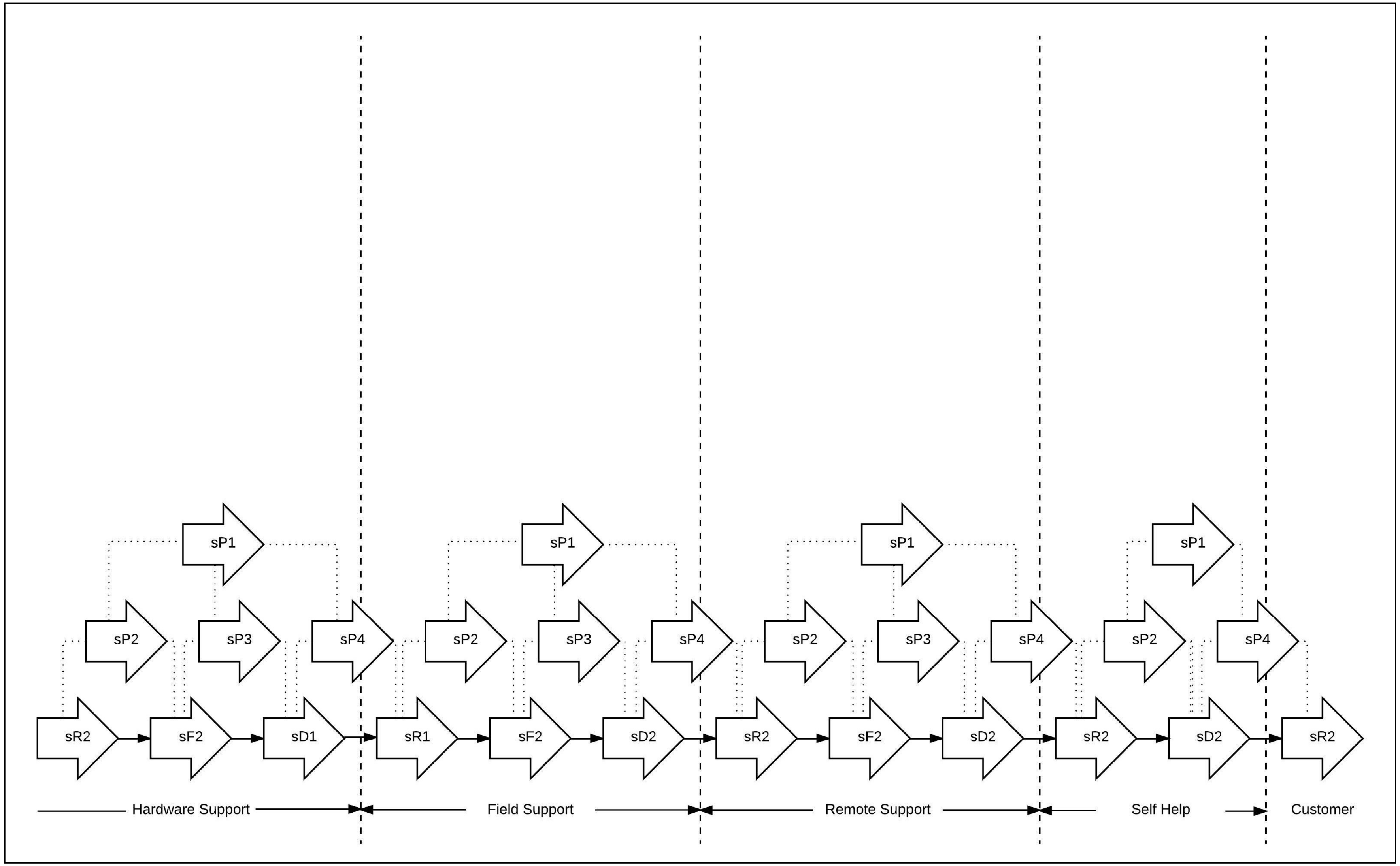

Figure 68: To-Be Process for End User Support

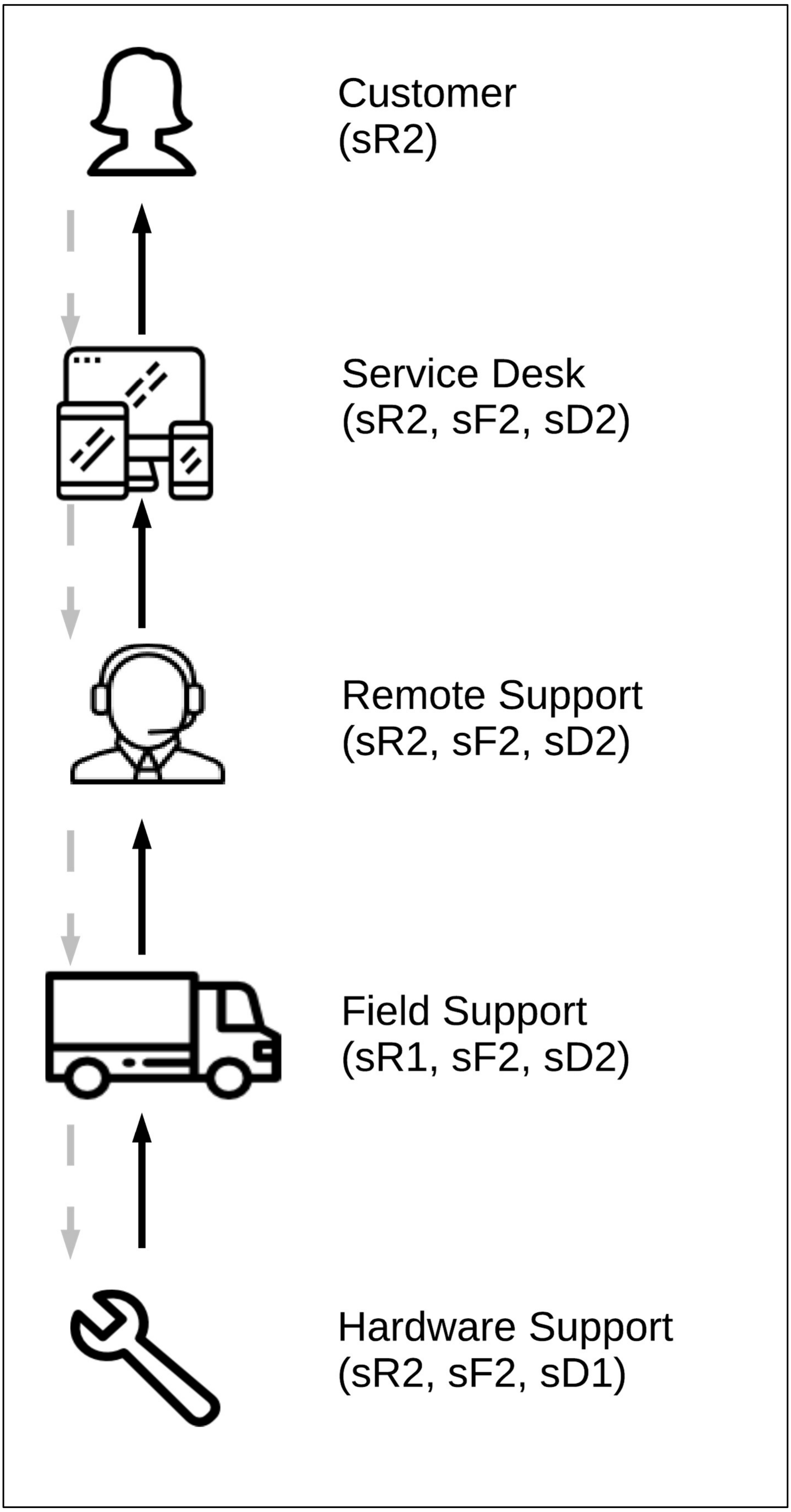

Figure 69: To-Be Supply Chain: End User Device

B.13.1 Exercise 7

1. Plot the to Be execution processes
2. Plot the plan processes of the execution processes
3. Plot the Plan 1 processes

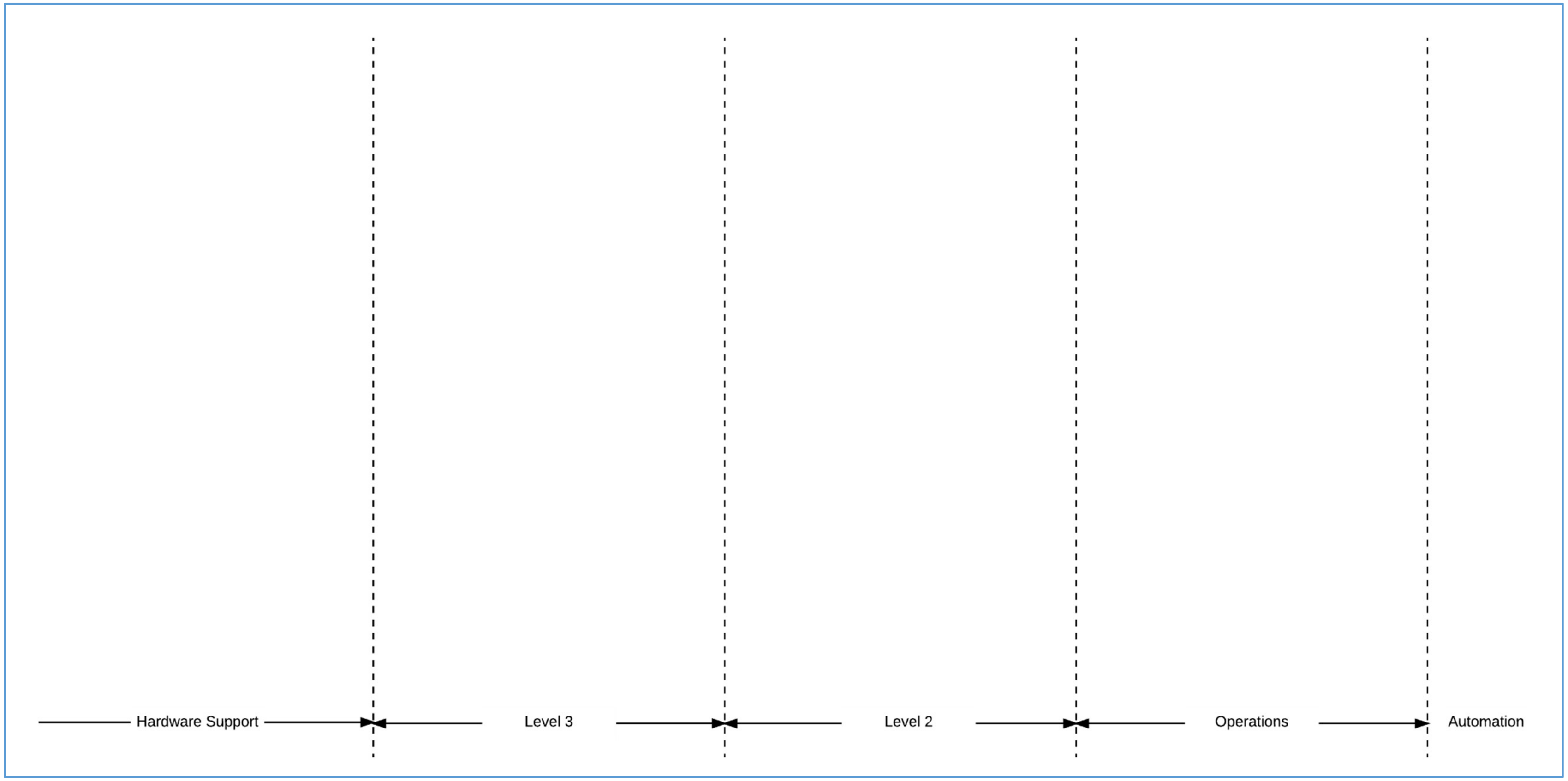

Figure 70: To-Be Process for Server Support

Now complete the following steps for the IT Server Support service on the map provided below

1. Draw the actors associated with the service supply chain
2. Draw the flow of services between the various entities starting from the final source item towards the customer
3. Add the SCOR level two process identifiers (R1, F1, D1, etc.) to the actors

Figure 71: To Be Supply Chain: IT Server Support Template (frame left intentionally blank)

B.14 Process Elements

The issue not introduced yet in this model is that of the process elements, or level three of the SCOR model. The reason is simply that the use of these elements is greatly up to the user of the model.

The process elements start to describe the main activities of each process. Note that the word start was used here; as it does not give the exact activities that you have to perform. It is rather a reference to activities that are suggested. These elements are of great value; it helps by providing a reference of the main processes that need to be performed. These are generic and are applicable to most businesses. The use of activities is left entirely to the discretion of the user of the model.

This tutorial will not show the use of these detailed process elements but will rather simply discuss the process element.

By way of example, consider the process of sF1 Fulfilled Scheduled Service (shown in Figure 72)

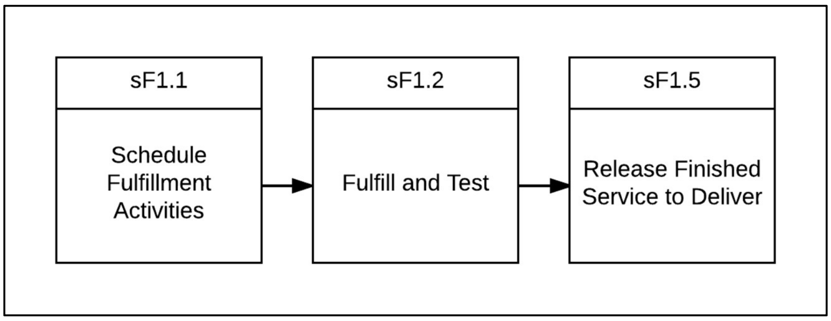

Figure 72: sF1 Fulfil Scheduled Service

From this the process steps linked to the Fulfil Scheduled Service follows a process of firstly assigning resources to complete the work, following the execution of the work and then the release of the work. Most of these items happen automatically as part of daily operations.

Detailed process steps exist for each of the process elements. They give a high level sequence of the steps to follow when the specific process step is used.

In addition to all the process steps, each of the organisations in the supply chain also has a number of process blocks seen as enabling blocks. These enabling blocks are used to give guidelines as to the supporting processes should be in place.

1) sE1 Manage Supply Chain Business Rules
2) sE2 Manage Performance
3) sE3 Manage Data and Information
4) sE4 Manage Supply Chain Human Resources
5) sE5 Manage Supply Chain Assets
6) sE6 Manage Supply Chain Contracts

7) sE7 Manage Supply Chain Network
8) sE8 Manage Regulatory Compliance
9) sE9 Manage Supply Chain Risk

B.14.1 Enabling Process Example

To consider the enabling process, the sE4 Manage Supply Chain Human Resources is reviewed. The steps linked to the sE4 process blocks are shown in Figure 73.

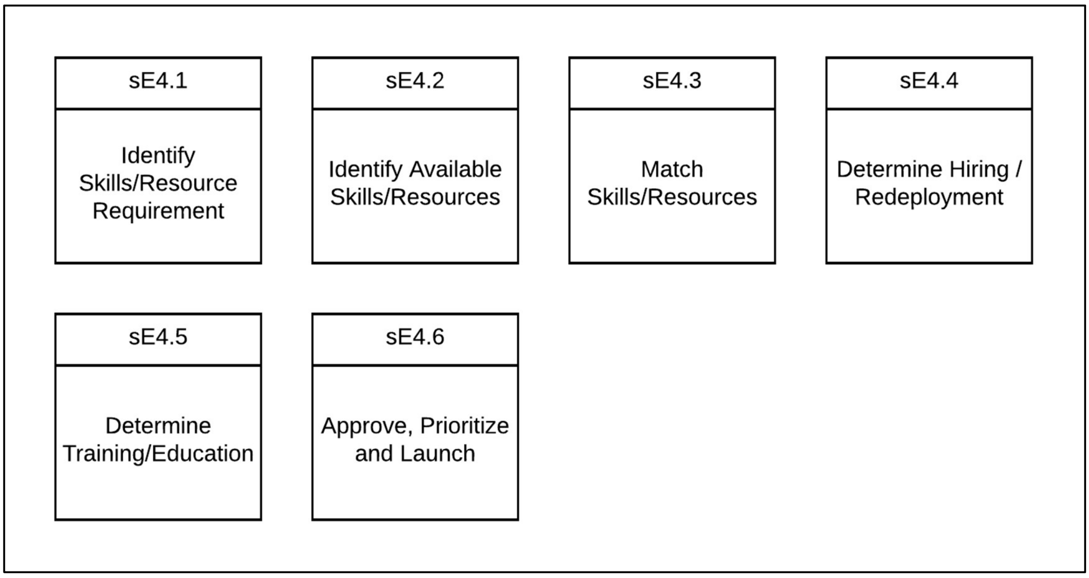

Figure 73: sE4 Manage Supply Chain Human Resources

Based on these steps the user gets an idea of the steps expected to ensure that the specific enabling activities are completed.

B.14.2 Exercise 8

Consider the process elements liked to Human Resources as a supporting process. Which of these steps do you currently have in place as you are managing your area within your overall service supply chain?

Identify Skills/Resource Requirement ☐

Identify Available Skills/Resources ☐

Match Skills/Resources ☐

Determine Hiring/Redeployment ☐

Determine Training/Education ☐

Approve, Prioritize and Launch $\square$

B.15 Conclusion

This tutorial was a quick tour of the adapted service SCOR model. It attempted to present the use and functionality of the model. As can be seen, its greatest use is the fact that it is already filled with information to put any practitioner on the right track when investigating a Supply Chain. Thinking of various metrics becomes much easier when there is already a number to choose from.

Another good feature of the model is the ability to customise it. This is a reference model, and is thus only the start to a company's own model.

Lastly it should he said that the adapted service SCOR model is only a tool to aid any practitioner. The final success of the Supply Chain relies on the thought and knowledge of the practitioner. Adapted service SCOR is only a modelling tool enabling various Supply Chain practitioners to speak the same language.